User Manual

Allen-Bradley

ControlLogix System User Manual

Catalog Numbers 1756-L61, 1756-L62, 1756-L63, 1756-L63XT, 1756-L64, 1756-L65, 1756-L71, 1756-L72, 1756-L73, 1756-L73XT, 1756-L74, 1756-L75

Important User Information

Solid-state equipment has operational characteristics differing from those of electromechanical equipment. Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls (publication SGI-1.1 available from your local Rockwell Automation® sales office or online at http://www.rockwellautomation.com/literature/) describes some important differences between solid-state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
	SHOCK HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

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This manual contains new and updated information. Changes throughout this revision are marked by change bars, as shown to the right of this paragraph.

New and Updated Information

This table contains the changes made to this revision.

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Preface

Studio 5000 Environment

The Studio 5000™ Engineering and Design Environment combines engineering and design elements into a common environment. The first element in the Studio 5000 environment is the Logix Designer application. The Logix Designer application is the rebranding of RSLogix™ 5000 software and will continue to be the product to program Logix5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.

The Studio 5000 environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. It is the one place for design engineers to develop all the elements of their control system.

ControlLogix Controllers Overview

There are three types of ControlLogix® controllers available. These types include the following:

- Standard ControlLogix controllers
- Extreme environment ControlLogix controller
- Safety GuardLogix® controllers

This manual explains how to use standard and extreme environment ControlLogix controllers.

For more information about using safety GuardLogix controllers, see the GuardLogix Controller Systems Safety Reference Manual, publication 1756-RM093, or the GuardLogix Controllers User Manual, publication 1756-UM020.

Standard ControlLogix Controllers

Two lines of standard ControlLogix controllers are now available. These controllers are identified as 1756-L6*x* controllers and 1756-L7*x* controllers according to abbreviations of their full catalog numbers.

Table 1 - ControlLogix Catalog Numbers

Abbreviated Cat. No.	Cat. No.
1756-L6*x*	1756-L61, 1756-L62,1756-L63, 1756-L64,1756-L65
1756-L7*x*	1756-L71, 1756-L72, 1756-L73,1756-L74, 1756-L75

The standard ControlLogix controllers share many similar features, but also have some differences. Table 2 provides a brief overview the differences between the controllers. For further details about these features and differences, see the appropriate chapters of this manual.

Table 2 - Differences Between 1756-L7*x* and 1756-L6*x* Controllers

Feature	1756-L7*x*	1756-L6*x*
Clock support and backup used for memory retention at powerdown	Energy Storage Module (ESM)	Battery
Communication ports (built-in)	USB	Serial
Connections, controller	500	250
Memory, nonvolatile	Secure Digital (SD) card	CompactFlash card
Status display and status indicators	Scrolling status display and four status indicators	Six status indicators
Unconnected buffer defaults	20 (40, max)	10 (40, max)

Redundant ControlLogix Controllers

Certain ControlLogix controllers are also supported for use in redundant systems. For more information about controllers and redundant systems, see Chapter 12.

Extreme Environment ControlLogix Controllers

The extreme environment ControlLogix controllers, catalog numbers 1756-L73XT and 1756-L63XT, provide the same functionality as the 1756-L73 and 1756-L63 controllers, but are designed to withstand temperatures -25...70 °C (-13...158 °F).

Before You Begin

Before you begin using your ControlLogix controller, verify that you have the applications required to configure and program the controller.

Required Software

Use this table to identify the minimum software versions required to use your ControlLogix controller.

Table 3 - Required Software for Controller Use

Cat. No.	Studio 5000 Environment	RSLogix 5000 Software	RSLinx® Classic
1756-L61/A	—	Version 12.06.00 or later	Any version
1756-L61/B	—	Version 13.04.00 or later	
1756-L62/A	—	Version 12.06.00 or later	
1756-L62/B	—	Version 13.04.00 or later	
1756-L63/A	—	• If not using a CompactFlash card, version 10.07.00 or later • If using a CompactFlash card, version 11.16.00 or later	
1756-L63/B	—	Version 13.04.00 or later	
1756-L63XT/B	—	Version 13.04.00 or later	Version 2.55.00 or later
1756-L64/B	—	Version 16.03.00 or later	Any version
1756-L65/B	—	Version 17.01.02 or later	
1756-L71/A	Version 21.00.00 or later	Version 20.01.02	Version 2.59.00 or later
1756-L72/A	Version 21.00.00 or later	Version 19.01.00 or later	Version 2.57.00 or later
1756-L73/A	Version 21.00.00 or later	Version 19.01.00 or later	
1756-L73XT/A	Version 21.00.00 or later	Version 19.01.00 or later	
1756-L74/A	Version 21.00.00 or later	Version 19.01.00 or later	
1756-L75/A	Version 21.00.00 or later	Version 19.01.00 or later	

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
1756 ControlLogix Controllers Technical Data, publication 1756-TD001	Provides specifications for ControlLogix controllers.
1756 ControlLogix I/O Modules Technical Data, publication 1756-TD002	Provides specifications for ControlLogix I/O modules.
ControlLogix Peer I/O Control Application Technique, publication 1756-AT016	Describes typical peer control applications and provides details about how to configure I/O modules for peer control operation.
Integrated Architecture and CIP Sync Configuration Application Technique, publication IA-AT003	Describes how to configure CIP Sync with Integrated Architecture™ products and applications.
ControlLogix Chassis and Power Supplies Installation Instructions, publication 1756-IN005	Describes how to install and troubleshoot standard and ControlLogix-XT™ versions of the 1756 chassis and power supplies, including redundant power supplies.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/literature/. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Install the 1756-L7*x* Controller

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ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

ATTENTION: Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and may not provide adequate protection to radio communication services in such environments.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, Rockwell Automation publication 1770-4.1, for additional installation requirements
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosure

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations.	**Informations sur l'utilisation de cet équipement en environnements dangereux.**
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.
WARNING: EXPLOSION HAZARD • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. • Substitution of components may impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area known to be nonhazardous.	**WARNING: RISQUE D'EXPLOSION** • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. • La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

European Hazardous Location Approval

The following applies when the product bears the Ex Marking.
This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

ATTENTION: This equipment is not resistant to sunlight or other sources of UV radiation.

WARNING:

- This equipment shall be mounted in an ATEX certified enclosure with a minimum ingress protection rating of at least IP54 (as defined in IEC60529) and used in an environment of not more than Pollution Degree 2 (as defined in IEC 60664-1) when applied in Zone 2 environments. The enclosure must utilize a tool removable cover or door.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- This equipment must be used only with ATEX certified Rockwell Automation backplanes.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

Before You Begin

Complete these tasks using the appropriate resources listed as references before you install your controller and power supply.

Task	Resources
Install a ControlLogix Chassis and Power Supply	Refer to ControlLogix Chasis and Power Supplies, publication 1756-IN005

1756-L7*x* Controller Parts

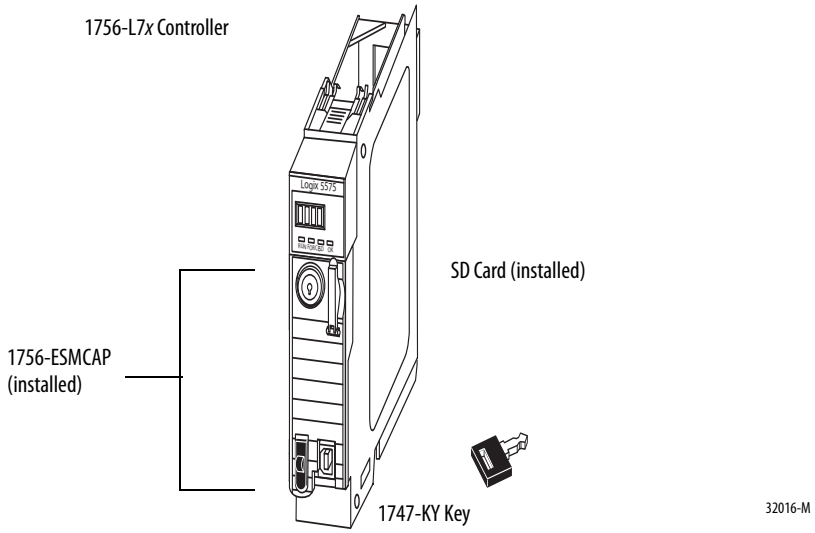
These sections describe parts that are included with the L7*x* controllers, as well as available accessory parts.

Parts Included with the 1756-L7*x* Controller

These parts are included with the controller:

- 1756-ESMCAP capacitor-based energy storage module (ESM)
- 1784-SD1 Secure Digital (SD) card, 1 GB
- 1747-KY controller key

Figure 1 - Parts with the 1756-L7*x* Controller



IMPORTANT The 1756-L7*x* controllers ship with an SD card installed. We recommend that you leave the SD card installed.

Parts Available for Use with the 1756-L7*x* Controller

In addition to parts included with the controller, you may choose to use these parts specific to your application.

If your application requires	Then use this part
USB connection from a computer to the controller	USB cable(1)
Nonvolatile memory	1784-SD1 (1 GB) or 1784-SD2 (2 GB)
ESM without WallClockTime back-up power	1756-ESMNSE This ESM does not have WallClockTime back-up power. Use this ESM if your application requires that the installed ESM deplete its residual stored energy to 40 µJoule or less before transporting it into or out of your application.(2) Additionally, you can use this ESM with a 1756-L73 (8 MB) or smaller memory-sized controller only.
ESM that secures the controller by preventing the USB connection and SD card use(2) This ESM provides your application an enhanced degree of security.	1756-ESMNRM

(1) The USB port is intended for temporary local programming purposes only and not intended for permanent connection. The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.

(2) For information about the hold-up time of the ESMs, see Hold-up Time (in days) on page 71 and stored energy depletion rate on page 26.

WARNING: Do not use the USB port in hazardous locations.

ATTENTION:

- The USB port is intended for temporary local programming purposes only and not intended for permanent connection.
- The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.

1756-L7*x* Controller Installation

These sections explain how to install the 1756-L7*x* controller. To install the 1756-L7*x* controller, complete the tasks summarized in this table.

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	Install the SD Card	21
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Insert the Controller into the Chassis

When installing a ControlLogix controller, you can do the following:

- Place the controller in any slot.
- Use multiple controllers in the same chassis.

You can install or remove a ControlLogix controller while chassis power is on and the system is operating.

WARNING: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both the controller and its mating connector on the chassis. Worn contacts may create electrical resistance that can affect controller operation.

ATTENTION: Prevent Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

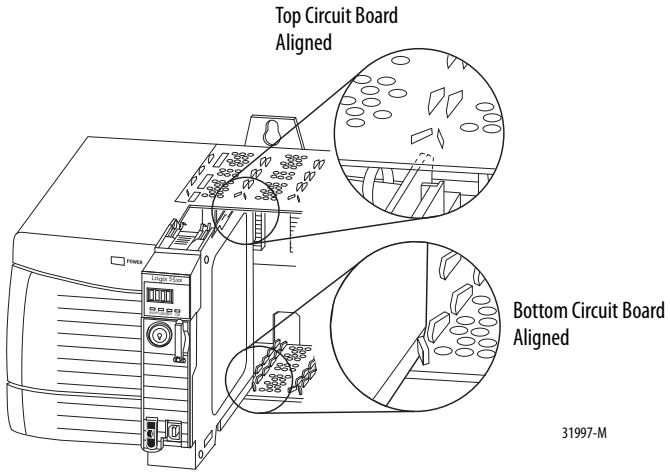
IMPORTANT

The ESM begins charging when one of these actions occurs:

- The controller and ESM are installed into a powered chassis.
- Power is applied to the chassis that contains a controller with the ESM installed.
- An ESM is installed into a powered controller.

After power is applied, the ESM charges for up to two minutes as indicated by CHRG or ESM Charging on the status display.

1. Align the circuit board with the top and bottom guides in the chassis.

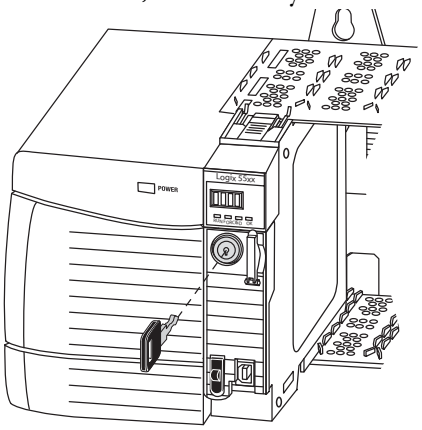


2. Slide the module into the chassis until it snaps into place.
3. Verify that the controller is flush with the power supply or other installed modules.

After you have inserted the controller into the chassis, reference the Status Indicators on page 185 for information about interpreting the status indicators.

Insert the Key

After the controller is installed, insert the key.



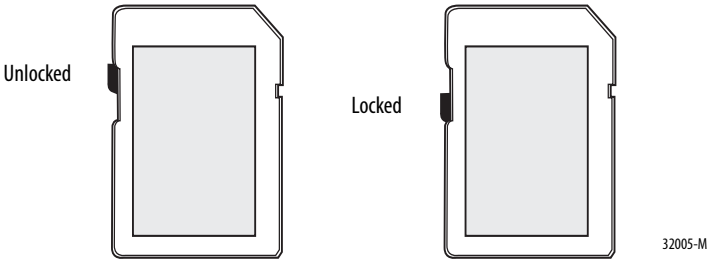
Install the SD Card

Complete these steps to install the SD card in the 1756-L7*x* controllers.

WARNING: When you insert or remove the Secure Digital (SD) memory card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

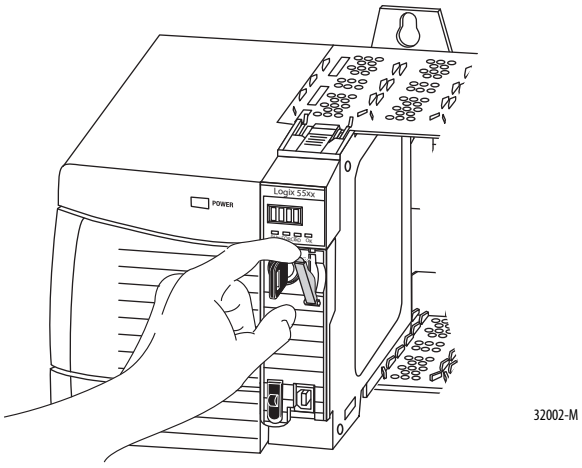
Be sure that power is removed or the area is nonhazardous before proceeding.

1. Verify that the SD card is locked or unlocked according to your preference.



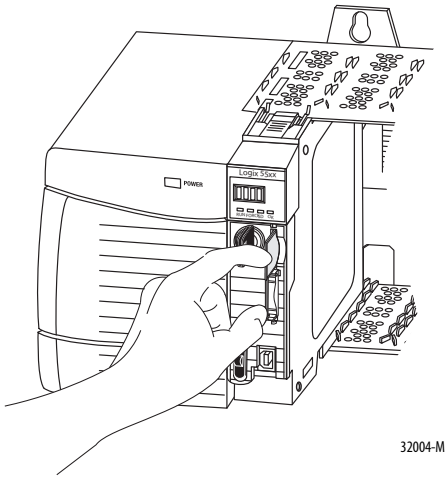
For more information about the lock/unlock memory settings, see the Load or Store to the Memory Card on page 64.

2. Open the door for the SD card.



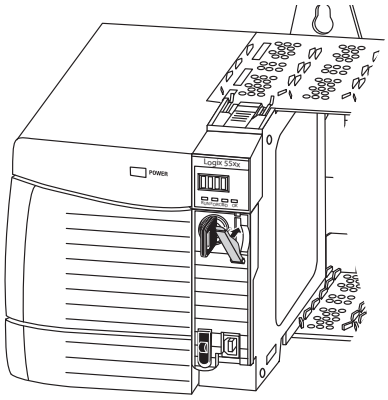
3. Insert the SD card into the SD card slot.

4. Gently press the card until it clicks into place.



32004-M

5. Close the SD card door.



32006-M

Remove the SD Card

The 1756-L7*x* controller ships with an SD card installed. Complete these steps to remove the SD card from the 1756-L7*x* controller.

WARNING: When you insert or remove the Secure Digital (SD) memory card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

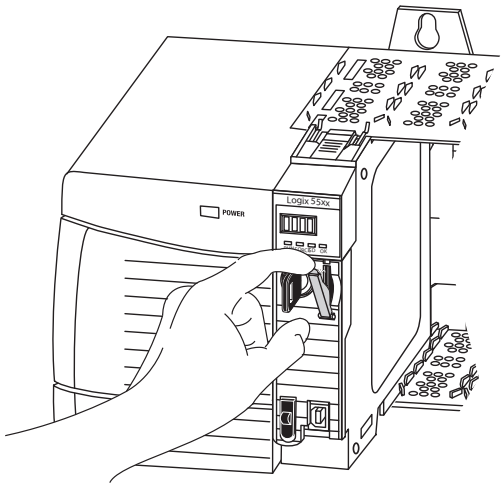
IMPORTANT

- Verify that the SD card status indicator is off and that the card is not in use before removing it.
- We recommend that you do the following:
  –Leave an SD card installed.
  – Use the SD cards available from Rockwell Automation (catalog number 1784-SD1 or 1784-SD2).
- While other SD cards may be used with the controller, Rockwell Automation has not tested the use of those cards with the controller. If you use an SD card other than those available from Rockwell Automation, you may experience data corruption or loss.
- Also, SD cards not provided by Rockwell Automation do not have the same industrial, environmental, and certification ratings as those available from Rockwell Automation.

1. Verify that the SD card is not in use by checking to be sure the SD indicator is Off.

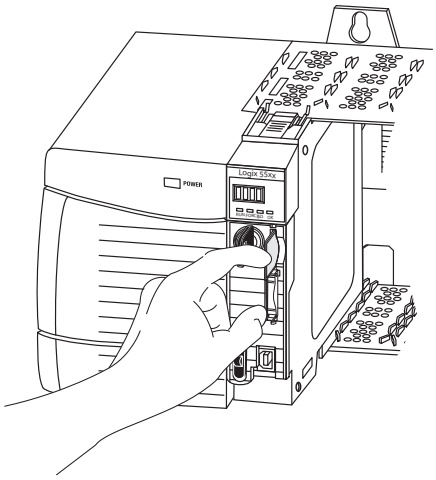
   TIP You may also put the controller into Hard Run mode to keep the controller from writing to the SD card while it is removed.

2. Open the door to access the SD card.



32015-M

3. Press and release the SD card to eject it.



32004-M

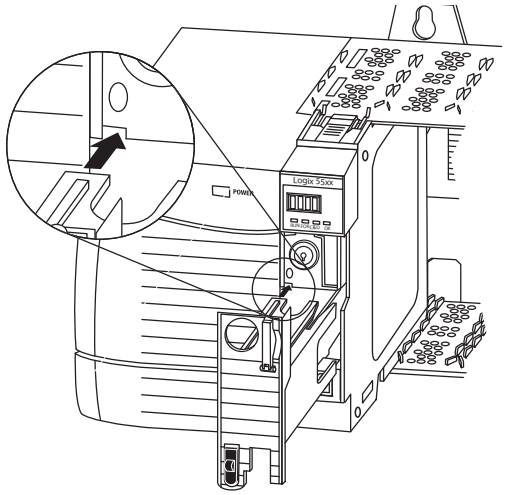
4. Remove the SD card and close the door.

Install the ESM

To install an ESM in the 1756-L7*x* controller, complete these steps.

ATTENTION: To avoid potential damage to the product when inserting the ESM, align it in the track and slide forward with minimal force until the ESM snaps into place.

1. Align the tongue-and-groove slots of the ESM and controller.



2. Slide the ESM back until it snaps into place.

   The ESM begins charging after installation. Charging status is indicated by one of these status messages:

   - ESM Charging
   - CHRG

   After you install the ESM, it may take up to 15 seconds for the charging status messages to display.

IMPORTANT Allow the ESM to finish charging before removing power from the controller. Failure to do so can result in the loss of the application program. A type 1, code 40 major fault will be logged on powerup.

To verify that the ESM is fully charged, check the status display to confirm that messages CHRG or ESM charging are no longer indicated.

TIP We recommend that you check the WallClockTime object attributes after installing an ESM to verify that time of the controller is correct.

The ESM contains a real-time clock. If the ESM is new or came from another controller, your controller's WallClockTime object attributes may change.

Uninstall the ESM

WARNING: If your application requires the ESM to deplete its residual stored energy to 40 µJoule or less before you transport it into or out of the application, use the **1756-(SP)ESMNSE(XT)** module only. In this case, complete these steps before you remove the ESM.

1. Turn power off to the chassis.
   After you turn power off to the chassis, the controller's OK status indicator transitions from green to solid red to OFF.
2. Wait **at least 20 minutes** for the residual stored energy to decrease to 40 µJoule or less before you remove the ESM.
   There is no visual indication of when the 20 minutes has expired. **You must track that time period**.

WARNING: When you insert or remove the energy storage module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both the module and its mating connector.

IMPORTANT Before you remove an ESM, make necessary adjustments to your program to account for potential changes to the WallClockTime attribute.

Consider these points before removing the ESM:

- The following ESM modules may be currently installed in your 1756-L7*x* or 1756-L7*x*XT controller:
  - 1756-ESMCAP
  - 1756-ESMNSE
  - 1756-ESMCAPXT
  - 1756-ESMNSEXT
- The 1756-L7*x* controllers come with the 1756-ESMCAP module already installed. The 1756-L7*x*XT extreme temperature controller ships with a 1756-ESMCAPXT module already installed. For more information on how to use a 1756-ESMNSE, 1756-ESMNRM, 1756-ESMNSEXT, or 1756-ESMNRMXT module, see page 25.
- After the 1756-L7*x* or 1756-L7*x*XT controllers lose power, either because the chassis power is turned off or the controller has been removed from a powered chassis, do not remove the ESM immediately.

  Wait until the controller's OK status indicator transitions from Green to Solid Red to OFF before you remove the ESM.
- You can use the 1756-ESMNSE module with a 1756-L73 (8MB) or smaller memory-sized controller only.

- Use the 1756-ESMNSE module if your application requires that the installed ESM deplete its residual stored energy to 40 µJoule or less before transporting it into or out of your application.
- Once it is installed, you cannot remove the 1756-ESMNRM or 1756-ESMNRMXT module from a 1756-L7*x* or 1756-L7*x*XT controller.

Complete these steps to remove an ESM module from the controller.

1. Remove the key from the mode switch.

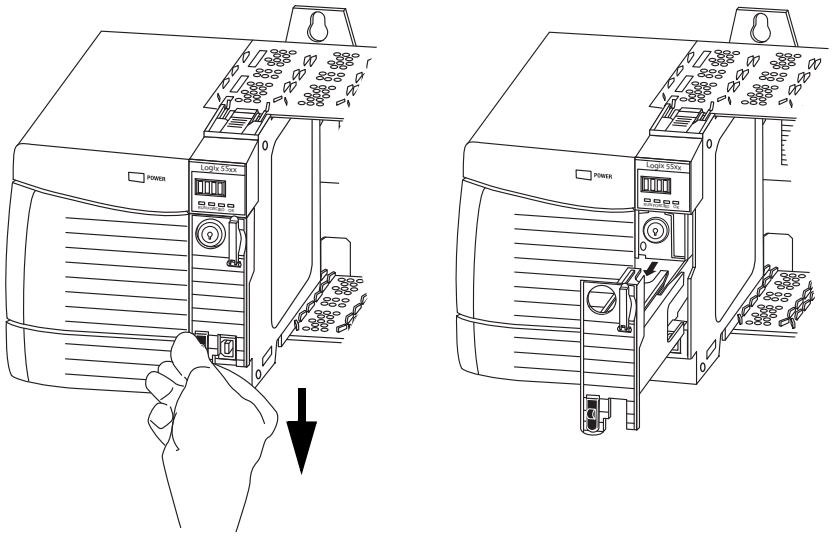
IMPORTANT The next step depends on which of the following conditions applies to your application.

- If you are removing the ESM from a powered 1756-L7*x* controller, go to step 2.
- If you are removing the ESM from a 1756-L7*x* controller that is not powered, either because the chassis power is turned off or the controller has been removed from a powered chassis, **do not remove** the ESM immediately.

  Wait until the controller's OK status indicator transitions from Green to Solid Red to OFF before you remove the ESM.

  After the OK status indicator transitions to Off, go to step 2.

2. Use your thumb to press down on the black release and pull the ESM away from the controller.



Notes:

Install the 1756-L6*x* Controller

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1756-L6x Controller Parts	31
1756-L6x Controller Installation	32
CompactFlash Card Installation and Removal	32
Battery Connection and Replacement	36
Insert the Controller into the Chassis	39
Remove the Controller from the Chassis	41

ATTENTION: Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in IEC 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and may not provide adequate protection to radio communication services in such environments.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional installation requirements.
- NEMA Standard 250 and IEC 60529, as applicable, for explanations of the degrees of protection provided by enclosures.

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations.	**Informations sur l'utilisation de cet équipement en environnements dangereux.**
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.

WARNING: EXPLOSION HAZARD

- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.
- Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Substitution of components may impair suitability for Class I, Division 2.
- If this product contains batteries, they must only be changed in an area known to be nonhazardous.

WARNING: RISQUE D'EXPLOSION

- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement.
- Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit.
- La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2.
- S'assurer que l'environnement est classé non dangereux avant de changer les piles.

European Hazardous Location Approval

The following applies when the product bears the Ex Marking.

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

ATTENTION: This equipment is not resistant to sunlight or other sources of UV radiation.

WARNING:

- This equipment shall be mounted in an ATEX certified enclosure with a minimum ingress protection rating of at least IP54 (as defined in IEC60529) and used in an environment of not more than Pollution Degree 2 (as defined in IEC 60664-1) when applied in Zone 2 environments. The enclosure must utilize a tool removable cover or door.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- This equipment must be used only with ATEX certified Rockwell Automation backplanes.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

ATTENTION: Personnel responsible for the application of safety-related programmable electronic systems (PES) shall be aware of the safety requirements in the application of the system and shall be trained in using the system.

Before You Begin

Complete these tasks using the appropriate resources listed as references before you install your controller and power supply.

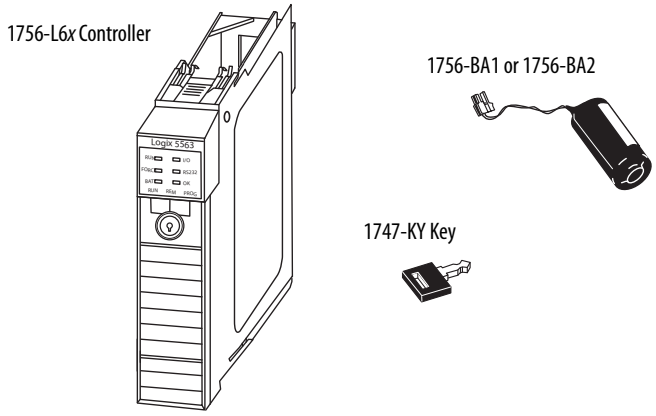
Task	Resources
Install a ControlLogix® Chassis and Power Supply	Refer to ControlLogix Chassis and Power Supplies, publication 1756-IN005

1756-L6*x* Controller Parts

These sections describe parts that are included with the 1756-L6*x* controllers, as well as available accessory parts:

- One of the following batteries is included with your controller:
  - For series A controllers, catalog number 1756-BA1
  - For series B controllers, catalog number 1756-BA2
- Key, catalog number 1747-KY

Figure 2 - Parts Included with the 1756-L6*x* Controller



Parts Not Included with the 1756-L6*x* Controller

In addition to parts included with the controller, you may choose to use these parts specific to your application.

If your application requires	Then use this component
RS-232 connection to the controller	1756-CP3 serial cable
Nonvolatile memory	1784-CF128 CompactFlash card
Expanded battery life for extended memory retention	1756-BATM battery module(1)

(1) The 1756-BATM can be used with series A controllers, but it cannot be used with series B controllers. Series B controllers use battery power differently than previous controllers and therefore battery considerations for this series controller vary. For more information about determining what battery to use, see the ControlLogix Controllers Selection Guide, publication 1756-SG001.

1756-L6*x* Controller Installation

These sections explain how to install a 1756-L6*x* controller. To install the 1756-L6*x* controller, complete the tasks summarized in this table.

✓	Task	Page
	CompactFlash Card Installation and Removal	32
	Battery Connection and Replacement	36
	Insert the Controller into the Chassis	39
	Remove the Controller from the Chassis	41

CompactFlash Card Installation and Removal

The installation and removal of a CompactFlash card depends on the controller.

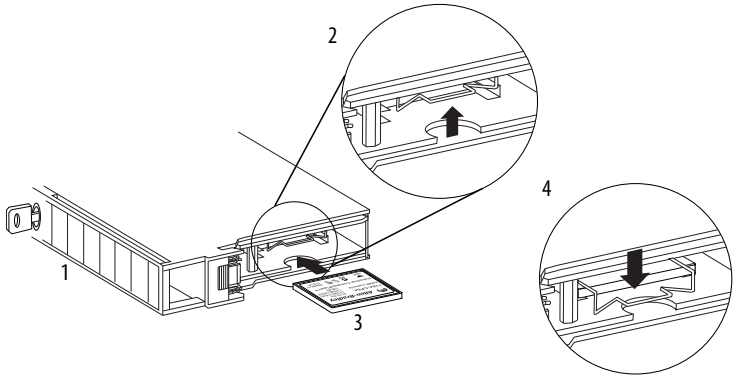
WARNING: When you insert or remove the CompactFlash Card while power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

- If you are using a series A controller, reference these sections:
  - Install a CompactFlash Card in a Series A Controller on page 33.
  - Remove a CompactFlash Card from a Series A Controller on page 33.
- If you are using a series B controller, reference these sections:
  - Install a CompactFlash Card in a Series B Controller on page 34.
  - Remove a CompactFlash Card from a Series B Controller on page 35.

Install a CompactFlash Card in a Series A Controller

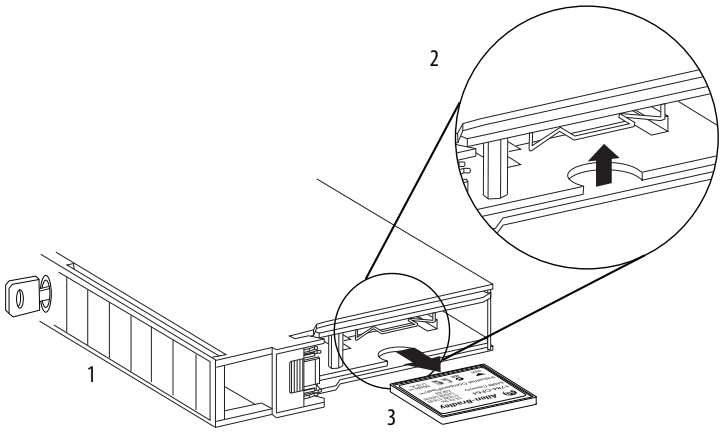
Complete these steps to install a CompactFlash card in a series A controller



1. Lay the controller on its side with the front facing to the left.
2. Raise the locking clip.
3. Insert the CompactFlash card into the slot at the bottom of the controller.
4. Pull the clip forward and then downward until it snaps into place over the card.

Remove a CompactFlash Card from a Series A Controller

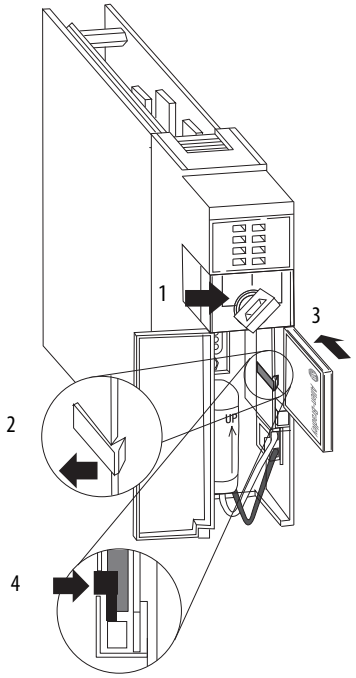
Complete these steps to remove a CompactFlash card from a series A controller.



1. Lay the controller in its side with the mode switch facing left.
2. Raise the locking clip.
3. Gently pull the card out of the slot.

Install a CompactFlash Card in a Series B Controller

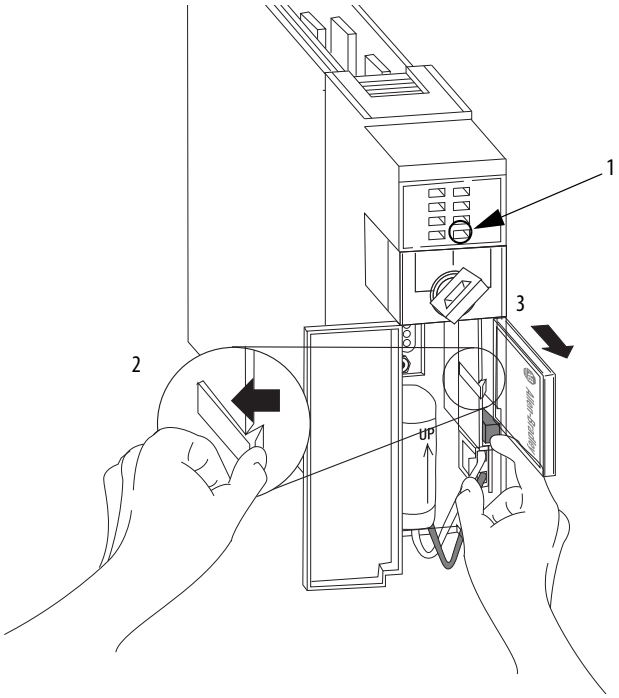
Complete these steps to install a CompactFlash card in a series B controller.



1. Open the door of the controller and push the CompactFlash latch to the left.
2. Insert the CompactFlash card with the Allen-Bradley® logo pointing left.
3. Release the latch and secure it over the CompactFlash card.

Remove a CompactFlash Card from a Series B Controller

Complete these steps to remove a CompactFlash card from a series B controller.



1. Verify that the OK indicator is solid green then open the door of the controller.
2. Push and hold the CompactFlash latch to the left.
3. Push the eject button and remove the card.
4. Release the latch.

Battery Connection and Replacement

This product contains a hermetically-sealed lithium battery that may need to be replaced during the life of the product.

At the end of its life, the battery contained in this product should be collected separately from any unsorted municipal waste.

The collection and recycling of batteries helps protect the environment and contributes to the conservation of natural resources as valuable materials are recovered.

WARNING: When you connect or disconnect the battery an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

For safety information on the handling of lithium batteries, including handling and disposal of leaking batteries, see Guidelines for Handling Lithium Batteries, publication AG-5.4.

IMPORTANT: To prevent program loss, replace a 1756-BA1 or 1756-BA2 battery according to the schedule below even if the BAT status indicator is Off.

If the temperature 2.54 cm (1 in.) below the chassis is	Replace the battery within
-25…35 °C (-13…95 °F)	No replacement required
36…40 °C (96.8…104 °F)	3 years
41…45 °C (105.8…113 °F)	2 years
46…50 °C (114.8…122 °F)	16 months
51…55 °C (123.8…131 °F)	11 months
56…70 °C (132.8…158 °F)	8 months

ATTENTION: Store batteries in a cool, dry environment. We recommend 25 °C (77 °F) with 40…60% relative humidity. You may store batteries for up to 30 days between -45…85 °C (-49…185 °F), such as during transportation. To avoid leakage or other hazards, **do not** store batteries above 60 °C (140 °F) for more than 30 days.

Connection of the battery varies depending on your controller series:

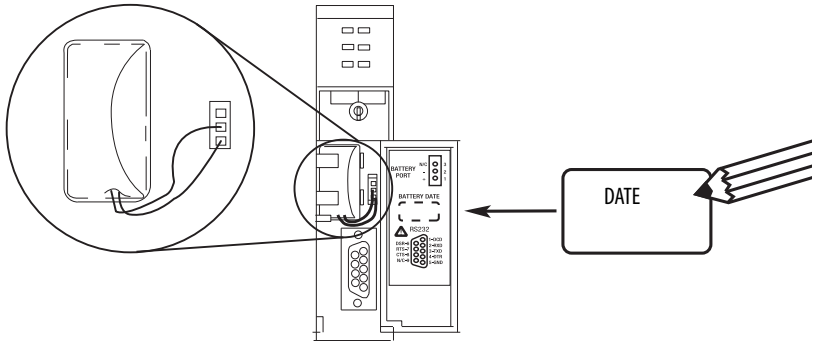
- If you are using a series A controller, see page 37.
- If you are using a series B controller, see page 38.

Install the Battery on a Series A Controller

Complete these steps to install a 1756-BA1 battery on a series A controller.

For information about installing a 1756-BATM battery module or replacing a 1756-BATM assembly, see the ControlLogix Battery Module Installation Instructions, publication 1756-IN578.

ATTENTION: For a series A controller, connect only a 1756-BA1 battery or a 1756-BATM battery module. The use of other batteries may damage the controller.



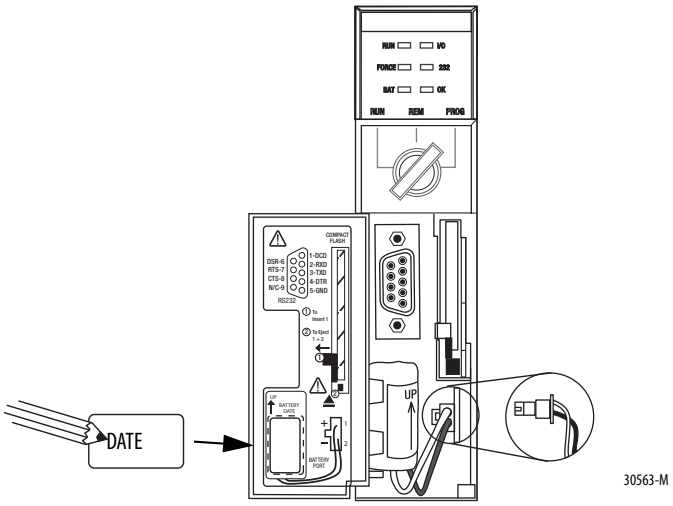
Wire Terminal Location	Connected Wire
Top	No connection
Middle	Black lead (-)
Bottom	Red lead (+)

1. Connect the battery connector to the port to the right of the battery slot.
2. Snap the battery into the battery slot.
3. Write the date on the battery label.
4. Attach the label to the inside of the controller door.

Install the Battery on a Series B Controller

Complete these steps to install the battery on a series B controller.

ATTENTION: For a series B controller, connect only a 1756-BA2 battery. The use of other batteries may damage the controller.



1. Insert the battery, with the arrow pointing up, into the battery slot.
2. Plug the battery connector into the battery port (+ Red, - Black).
3. Write the date on the battery label.
4. Attach the label to the inside of the controller door.

Insert the Controller into the Chassis

When installing a ControlLogix controller, you can do the following:

- Place the controller in any slot.
- Use multiple controllers in the same chassis.

You can install a ControlLogix controller while chassis power is on and the system is operating.

WARNING: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Repeated electrical arcing causes excessive wear to contacts on both the controller and its mating connector on the chassis. Worn contacts may create electrical resistance that can affect controller operation.

ATTENTION: Prevent Electrostatic Discharge

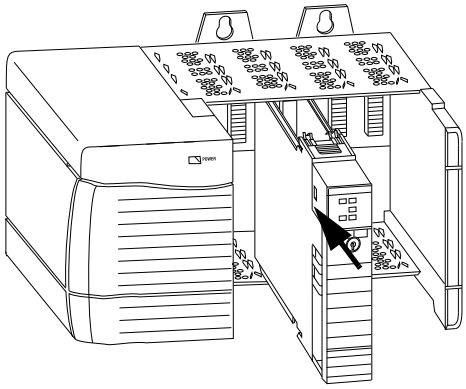
This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

ATTENTION: If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Complete these steps to insert the controller into the chassis.

1. Insert the key into the controller.
2. Turn the key to the PROG position.
3. Align the circuit board with the top and bottom guides in the chassis.
4. Slide the module into the chassis.



5. Verify that the controller is flush with the power supply or other installed modules.
6. Verify that the top and bottom latches are engaged.

After you have inserted the controller into the chassis, you may need to reference the Status Indicators on page 185 for more information related to the state of the controller.

Remove the Controller from the Chassis

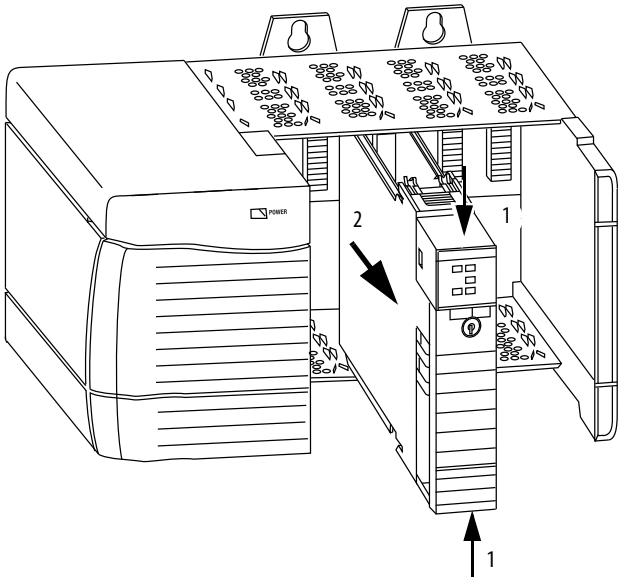
You can remove a controller while chassis power is on and the system is operating. If you remove the controller, all of the devices owned by the controller go to their configured fault state.

WARNING: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

Repeated electrical arcing causes excessive wear to contacts on both the controller and its mating connector in the chassis. Worn contacts may create electrical resistance that can affect controller operation.

Complete these steps to remove the controller from the chassis.

1. Press the locking tabs on the top and bottom of the controller.
2. Slide the controller out of the chassis.



Notes:

Start Using the Controller

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Make Connections

Before you can begin using your controller, you must make a connection to the controller.

1756-L7*x* Connection Options

Connection options with the 1756-L7*x* include the following:

- Connect using a **USB cable** as described in Connect to the 1756-L7x Controller on page 44.
- Install and configure a **communication module** in the chassis with the controller as described in the installation instructions for the communication module.

For information on Double Data Rate (DDR) backplane communication usage, see Double Data Rate (DDR) Backplane Communication on page 87.

1756-L6*x* Connection Options

Connection options with the 1756-L6*x* include the following:

- Connect using a **serial cable** as described in Connect to the 1756-L6x Controller on page 47.
- Install and configure a **communication module** in the chassis with the controller as described in the installation instructions for the communication module.

TIP When upgrading your 1756-L6*x* controller firmware, we recommend you use a network connection other than the serial cable. Serial connections are much slower than other communication connections.

Connect to the 1756-L7*x* Controller

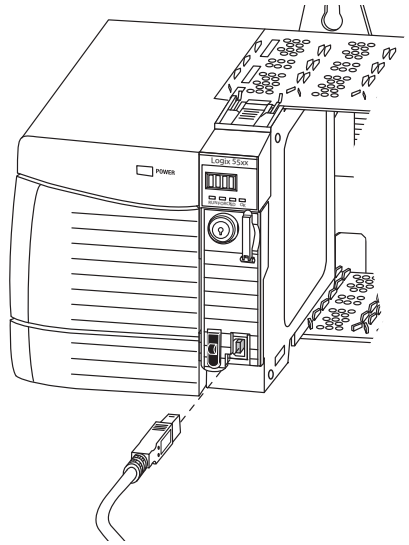
The controller has a USB port that uses a Type B receptacle. The port is USB 2.0 compatible and runs at 12 Mbps.

To use the USB port of the controller, you must have RSLinx software, version 2.56 or later, installed on your workstation. Use a USB cable to connect your workstation to the USB port. With this connection, you can upgrade firmware and download programs to the controller directly from your workstation.

ATTENTION: The USB port is intended for temporary local programming purposes only and not intended for permanent connection. The USB cable is not to exceed 3.0 m (9.84 ft) and must not contain hubs.

WARNING: Do not use the USB port in hazardous locations.

Figure 3 - USB Connection



Set Up the USB Driver

To configure RSLinx software to use a USB port, you need to first set up a USB driver.

To set up a USB driver, perform this procedure.

1. Connect your controller and workstation by using a USB cable.

   The Found New Hardware Wizard dialog box appears.

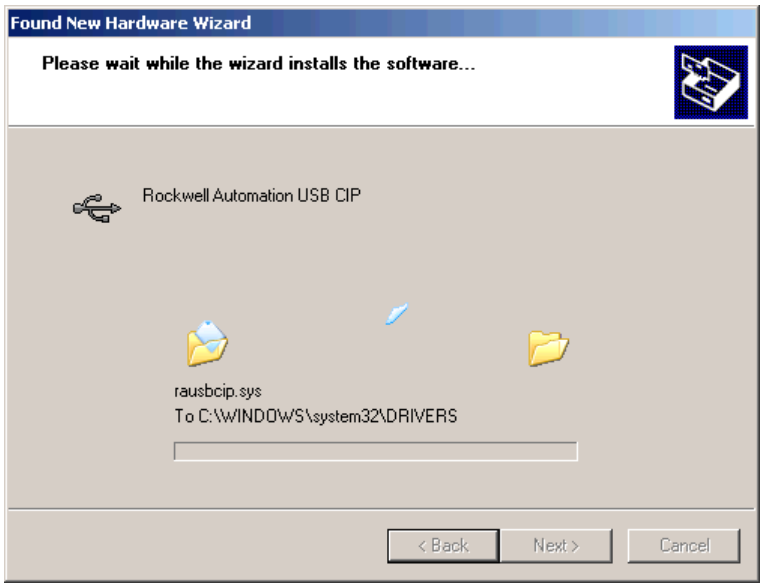
Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel

2. Click any of the Windows Update connection options and click Next.

   TIP If the software for the USB driver is not found and the installation is canceled, verify that you have installed RSLinx Classic software, version 2.57 or later.

3. Click Install the software automatically (Recommended) and click Next.

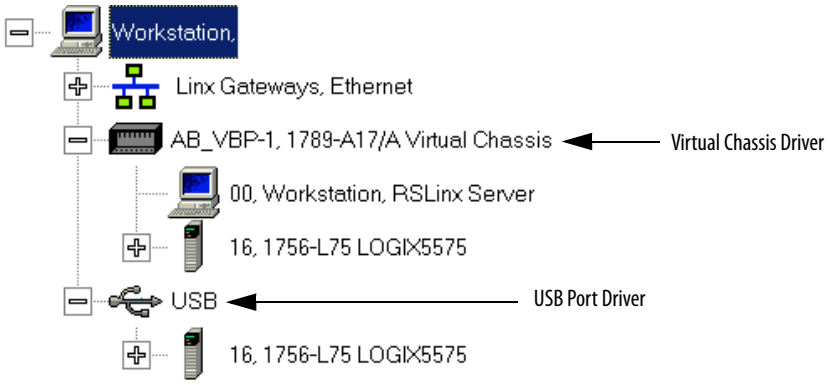
   The software is installed.



4. Click Finish to set up your USB driver.

   To browse to your controller in RSLinx software, click the RSWho icon.

   The RSLinx Workstation organizer appears.



Your controller appears under two different drivers, a virtual chassis and the USB port. You can use either driver to browse to your controller.

Connect to the 1756-L6*x* Controller

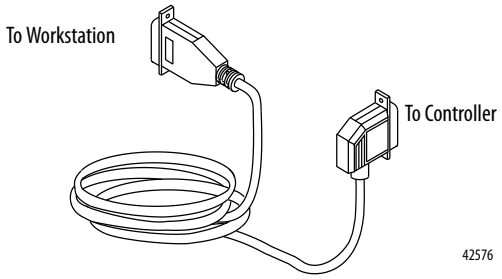
The 1756-L6*x* ControlLogix controller uses a serial port for workstation connections.

WARNING: If you connect or disconnect the serial cable with power applied to this module or the serial device on the other end of the cable, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

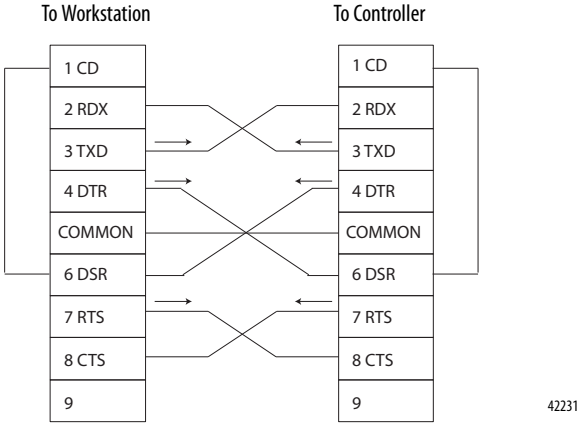
To connect a workstation to the serial port, you can make your own serial cable or use one of these cables:

- 1756-CP3 serial cable
- 1747-CP3 cable from the SLC™ product family (if you use this cable, the controller door may not close)

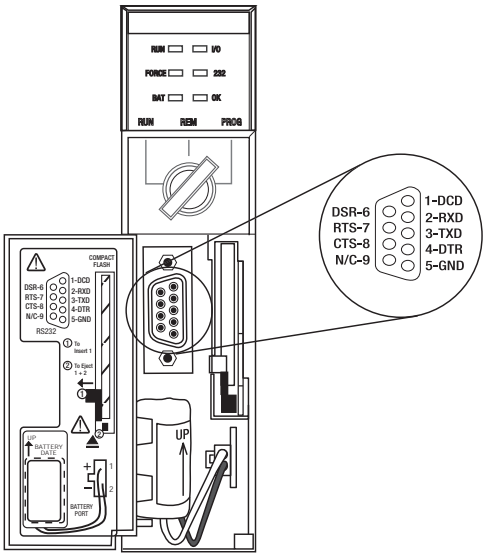


Follow these guidelines if you make your own serial cable:

- Limit the length to 15.2 m (50 ft).
- Wire the connectors as shown.
- Attach the shield to both connectors.



Plug the controller end of the serial cable into the RS-232 port on the front of the controller.

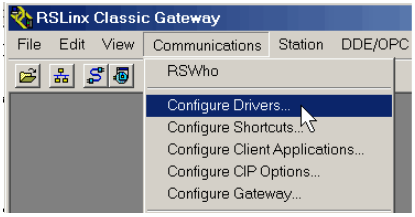


Configure the Serial Driver

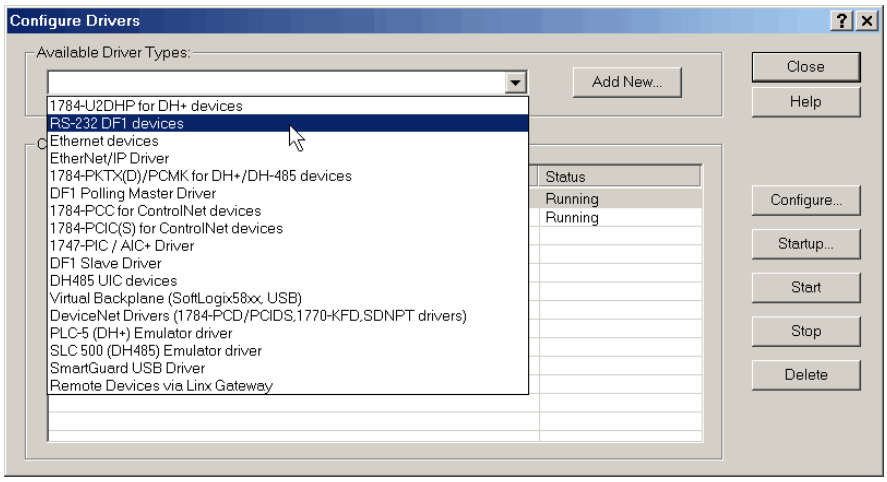
Use RSLinx software to configure the RS232 DF1 device driver for serial communication.

To configure the driver, perform this procedure.

1. In RSLinx software, from the Communications menu, choose Configure Drivers.

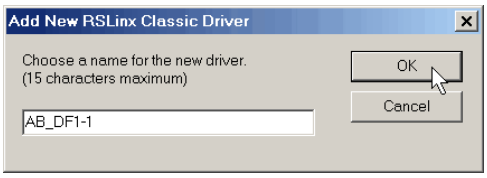


2. From the Available Driver Types pull-down menu, choose the RS-232 DF1 device driver.



3. Click Add New.

   The Add New RSLinx Driver dialog box appears.



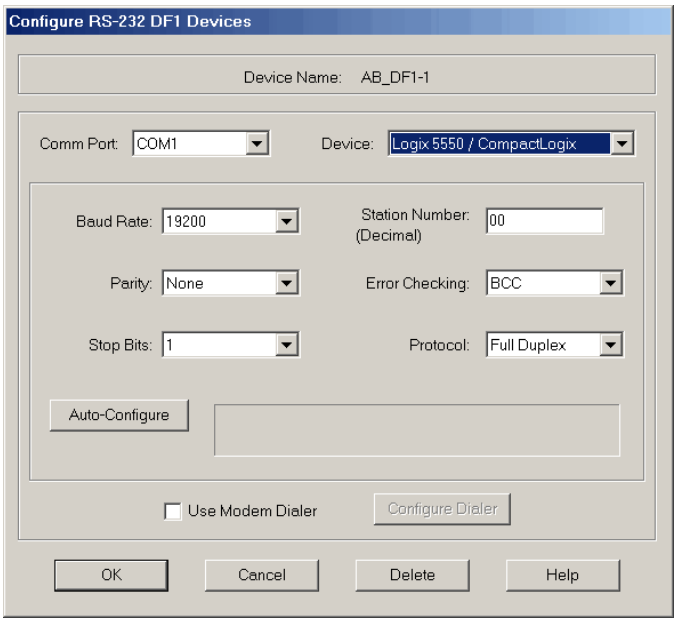
4. Type the driver name and click OK.

5. Specify the serial port settings.

   a. From the Comm Port pull-down menu, choose the serial port on the workstation to which the cable is connected.

   b. From the Device pull-down menu, choose Logix 5550/ CompactLogix™.

   c. Click Auto-Configure.



6. If the auto configuration is successful, click OK.

   If the auto configuration is not successful, verify that the correct Comm Port was selected.

7. Click Close.

Upgrade Controller Firmware

You may choose to upgrade controller firmware by using either of these tools:

- ControlFLASH™ software packaged with the Studio 5000 environment
- AutoFlash feature of the Logix Designer application

To upgrade your controller firmware, complete the tasks listed in this table.

✓	Task	Page
	Determine Required Controller Firmware	50
	Obtain Controller Firmware	51
	Use ControlFLASH Utility to Upgrade Firmware	51
	Use AutoFlash to Upgrade Firmware	54

Determine Required Controller Firmware

IMPORTANT The controller must be in Remote Program or Program mode and all major recoverable faults cleared to accept upgrades.

Use this table to determine what firmware revision is required for your controller.

Table 4 - Firmware Required For Controllers

Controller	Series	Use this firmware revision
1756-L61	A	12.*x* or later
	B	13.40 or later
1756-L62	A	12.*x* or later
	B	13.40 or later
1756-L63	A	• If not using a CompactFlash card, 10.*x* or later • If using a CompactFlash card, 11.*x* or later
	B	13.40 or later
1756-L63XT	B	13.40 or later
1756-L64	B	16 or later
1756-L65	B	17 or later
1756-L71	A	20 or later
1756-L72	A	19 or later
1756-L73	A	19 or later
1756-L73XT	A	19 or later
1756-L74	A	19 or later
1756-L75	A	19 or later

Obtain Controller Firmware

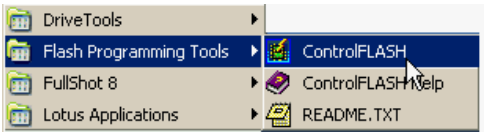
Controller firmware is packaged with the Studio 5000 environment. In addition, controller firmware is also available for download from the Rockwell Automation Technical Support website at http://www.rockwellautomation.com/support/.

Use ControlFLASH Utility to Upgrade Firmware

To upgrade your controller firmware with ControlFLASH software, complete these steps.

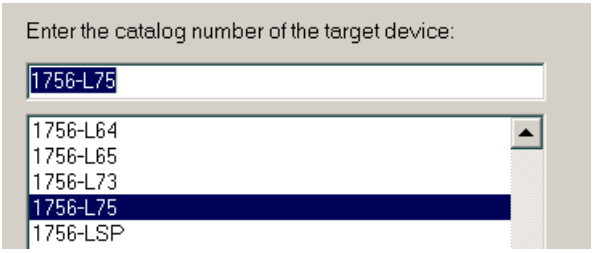
IMPORTANT If the SD card is locked and the stored project's Load Image option is set to On Power Up, the controller firmware is not updated as a result of these steps. The previously-stored firmware and project are loaded instead.

1. Verify that the appropriate network connection is made and the network driver has been configured in RSLinx software.
2. Start ControlFLASH software and click Next to begin the upgrade process.

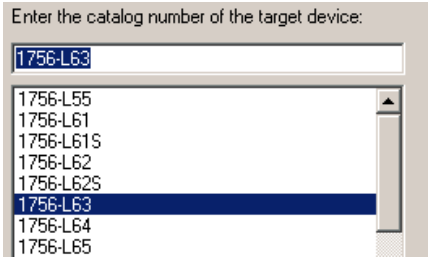


3. Select the catalog number of your controller and click Next.

1756-L7*x* Controllers

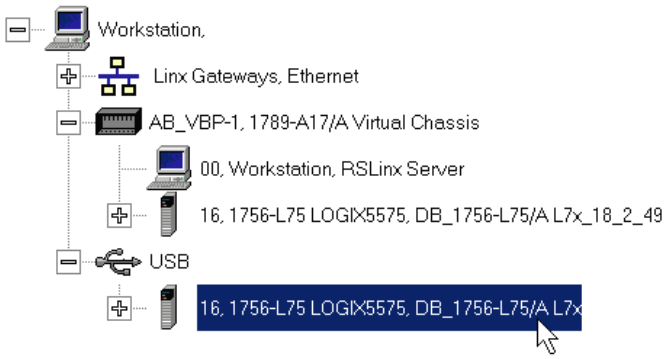


1756-L6*x* Controllers

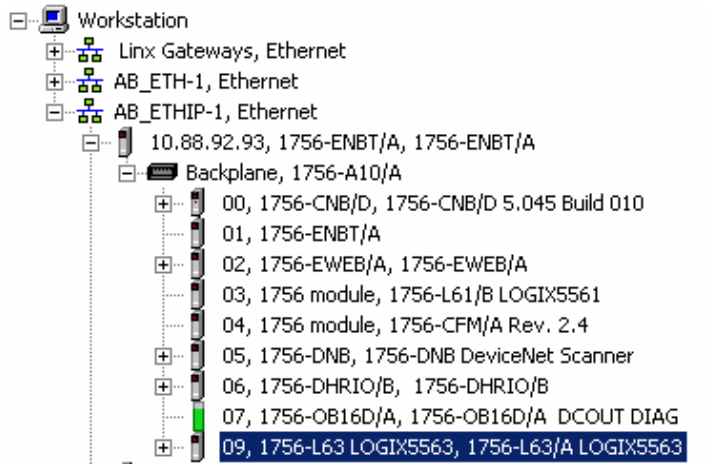


4. Expand the network driver to locate your controller.

1756-L7*x* Controller with USB Network Driver

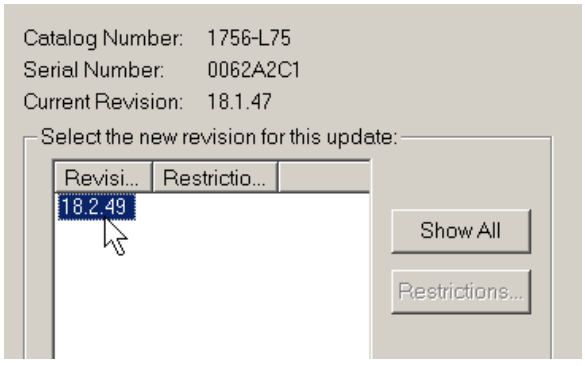


1756-L6*x* Controller with Ethernet Network Driver

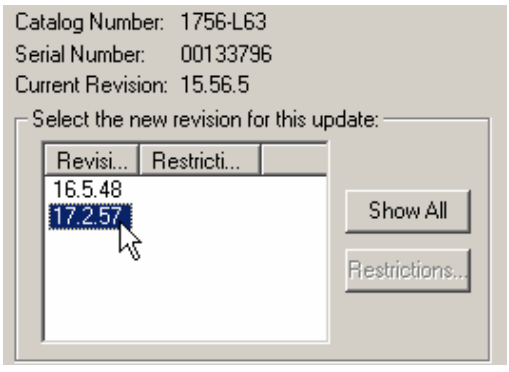


5. Select the controller and click Next.
6. Select the firmware revision you want to upgrade to and click Next.

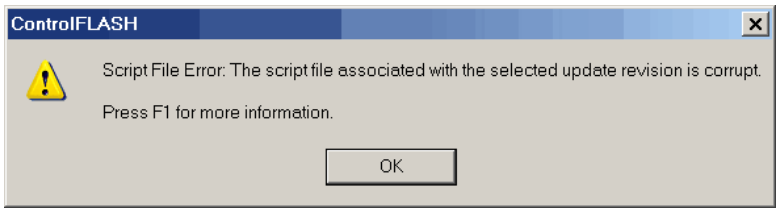
1756-L7*x* Controller Upgrade



1756-L6*x* Controller Upgrade



TIP If you are using a 1756-L7*x* controller and experience a Script File Error after selecting the firmware revision number (see the example below), there is likely an anomaly with your firmware files.


ControlFLASH
Script File Error: The script file associated with the selected update revision is corrupt.
Press F1 for more information.
OK

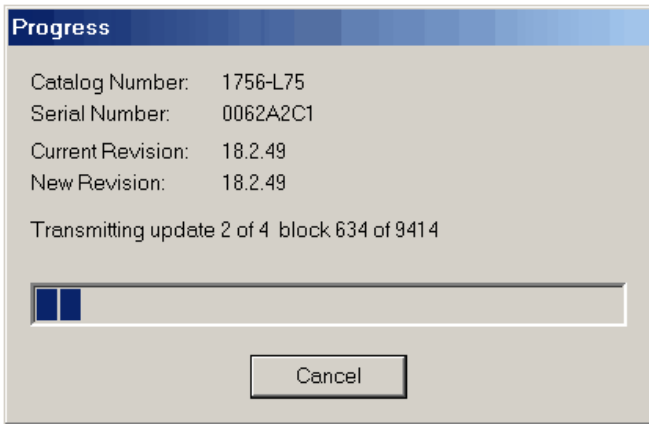
To recover, take these actions:

- Go to http://www.rockwellautomation.com/support/ and download the firmware revision you are trying to upgrade. Replace the firmware revision you have previously installed with that posted on the Technical Support website.
- If replacing your firmware revision does not resolve the anomaly, contact Rockwell Automation Technical Support.

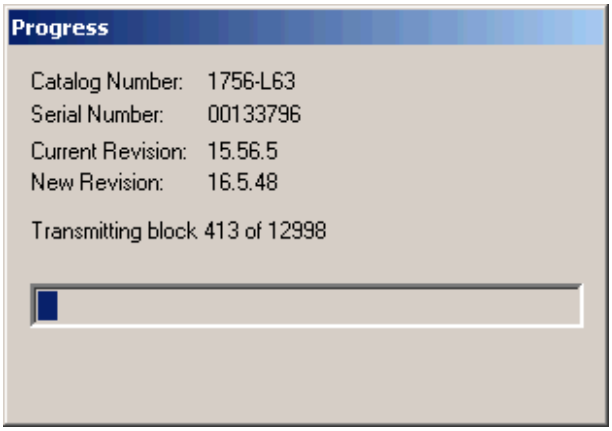
7. Click Finish.
8. When a confirmation dialog box appears, click Yes.

   The progress dialog box indicates the progress of the firmware upgrade. 1756-L7*x* controllers indicate progress in updates and blocks. 1756-L6*x* controllers indicate progress only in blocks.

1756-L7*x* Controller Progress



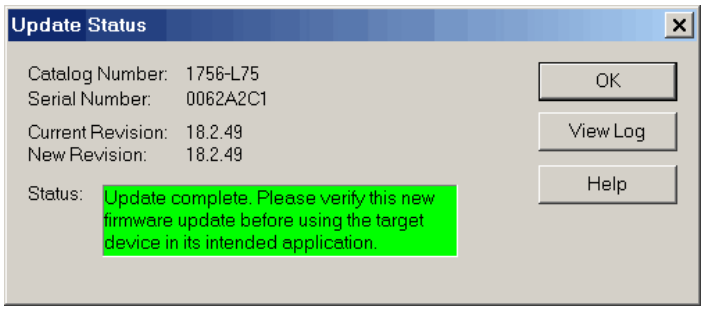
1756-L6*x* Controller Progress



WARNING: Allow the firmware update to fully complete before cycling power or otherwise interrupting the upgrade.

TIP If the ControlFLASH upgrade of the controller is interrupted, the 1756-L6*x* and 1756-L7*x* controllers revert to boot firmware, that is firmware revision 1.*xxx*.

When the upgrade is complete, the Update Status dialog box indicates that the upgrade is complete.


Update Status
Catalog Number: 1756-L75
Serial Number: 0062A2C1
Current Revision: 18.2.49
New Revision: 18.2.49
Status: Update complete. Please verify this new firmware update before using the target device in its intended application.
OK
View Log
Help

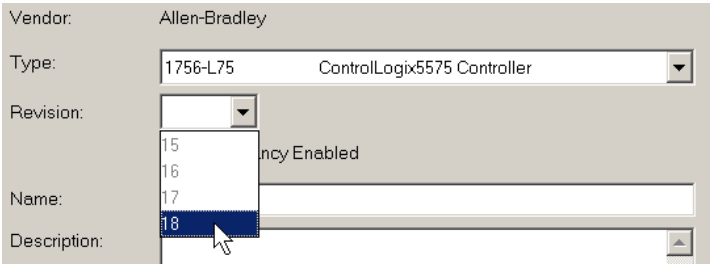
9. Click OK.
10. Close ControlFLASH software.

Use AutoFlash to Upgrade Firmware

To upgrade your controller firmware with the AutoFlash feature, complete these steps.

IMPORTANT If the SD card is locked and the stored project's Load Image option is set to On Power Up, the controller firmware is not updated as a result of these steps. The previously-stored firmware and project are loaded instead.

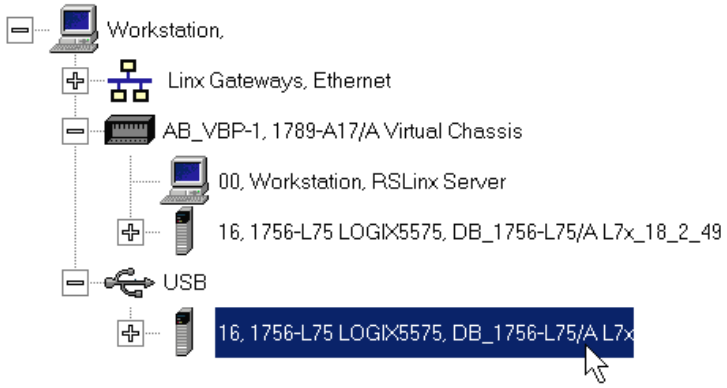
1. Verify that the appropriate network connection is made and your network driver is configured in RSLinx software.
2. Use the Logix Designer application to create a controller project at the version you need.



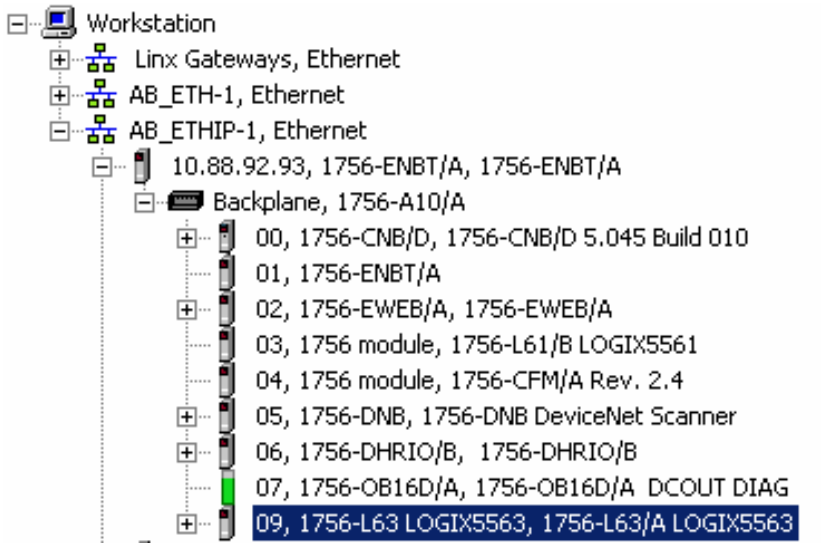
3. Click RSWho to specify the controller path.

4. Select your controller and click Update Firmware.

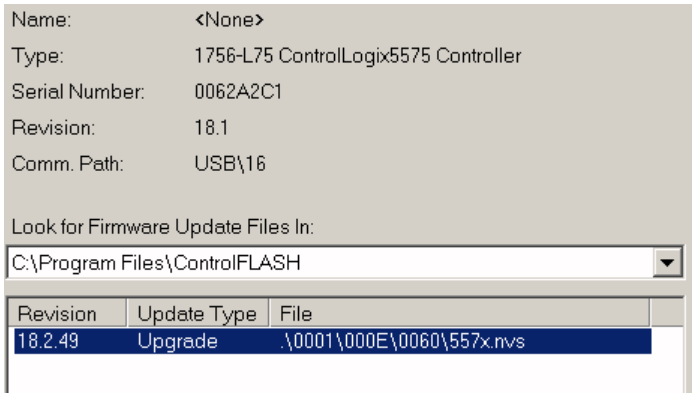
1756-L7*x* Controller with USB Driver



1756-L6*x* Controller with Ethernet Driver

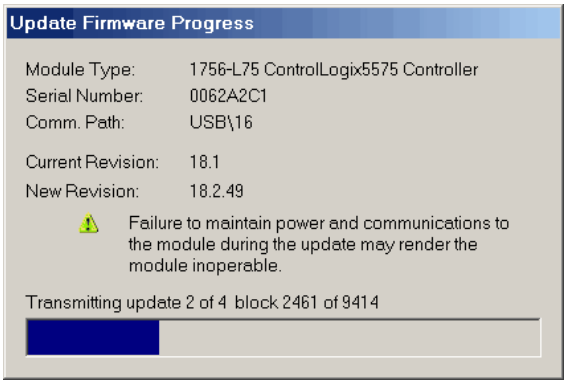


5. Select the firmware revision to upgrade to and click update.



6. Click Yes.

   The firmware upgrade begins.


Update Firmware Progress
Module Type: 1756-L75 ControlLogix5575 Controller
Serial Number: 0062A2C1
Comm. Path: USB\16
Current Revision: 18.1
New Revision: 18.2.49
Failure to maintain power and communications to the module during the update may render the module inoperable.
Transmitting update 2 of 4 block 2461 of 9414

   Allow the firmware upgrade to complete without interruption.

   When the firmware upgrade is complete, the Who Active dialog box opens.

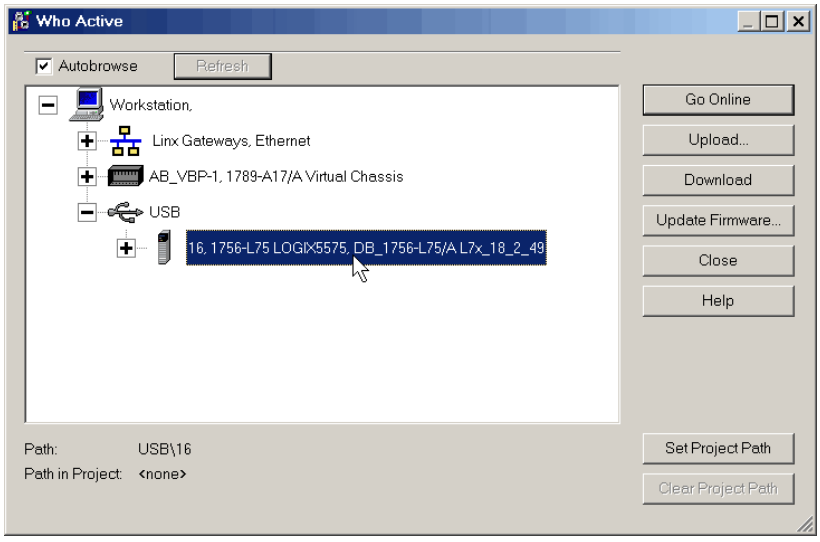
Set the Communication Path

To get online with the controller, you must specify a communication path in the Logix Designer application. You specify the communication path after you create a controller program.

Complete these steps to specify the communication path after you have created your program.

1. Click Who Active.

2. Expand the communication path and select the controller.

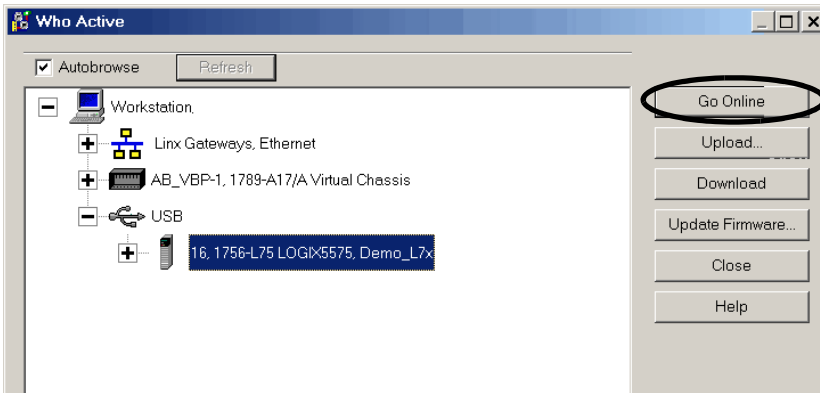


3. Click Set Project Path.

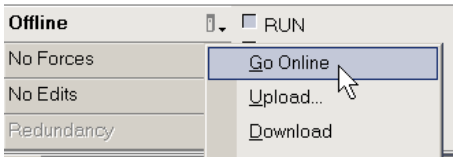
Go Online with the Controller

Use one of these methods to go online with the controller:

- After setting the communication path, click Go Online in the Who Active dialog box.



- From the Controller Status menu, choose Go Online.



Download to the Controller

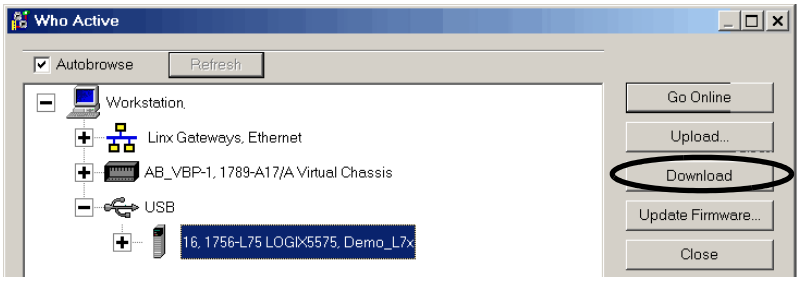
Downloading a project to the controller moves the project from the Logix Designer application onto the controller. You can download a project in two ways:

- Use the Who Active Dialog Box to Download on page 58
- Use the Controller Status Menu to Download on page 59

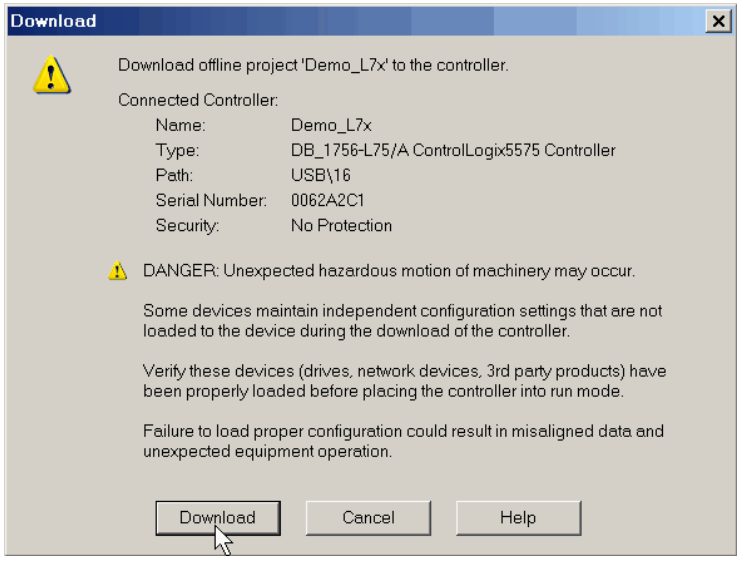
Use the Who Active Dialog Box to Download

You can use the features of the Who Active dialog box to download to your controller after you have set the communication path. Complete these steps to download to the controller.

1. After setting the communication path, click Download in the Who Active dialog box.



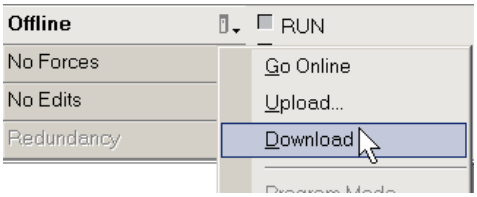
2. Click Download after reading the warnings in the Download dialog box.


Download
Download offline project 'Demo_L7x' to the controller.
Connected Controller:
Name: Demo_L7x
Type: DB_1756-L75/A ControlLogix5575 Controller
Path: USB\16
Serial Number: 0062A2C1
Security: No Protection
DANGER: Unexpected hazardous motion of machinery may occur.
Some devices maintain independent configuration settings that are not loaded to the device during the download of the controller.
Verify these devices (drives, network devices, 3rd party products) have been properly loaded before placing the controller into run mode.
Failure to load proper configuration could result in misaligned data and unexpected equipment operation.
Download
Cancel
Help

Use the Controller Status Menu to Download

After you set a communication path in the Logix Designer application, you can use the Controller Status menu to download to the controller. To download, from the Controller Status menu, choose Download.

Figure 4 - Download via the Controller Status Menu



TIP After the download completes on a 1756-L7*x* controller, the project name is indicated on the scrolling status display.

Upload from the Controller

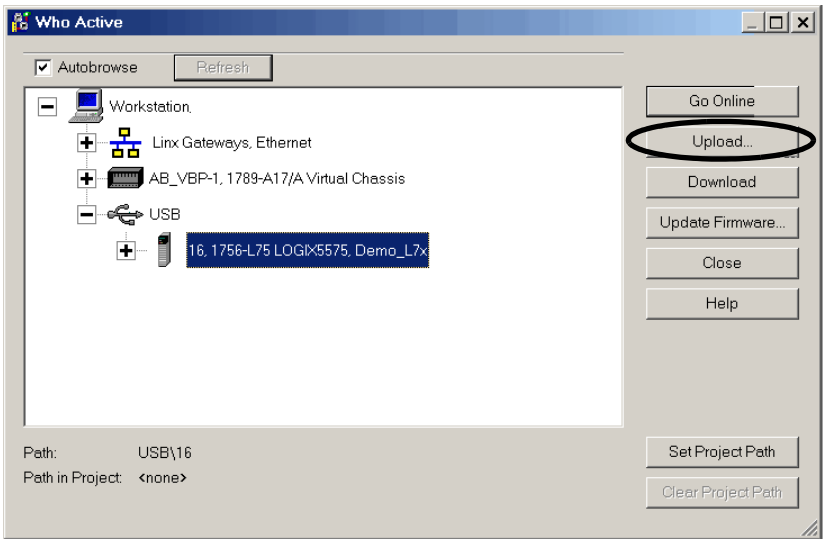
Uploading a project to the controller copies the project from the controller to the Logix Designer application. To upload a project, use one of these methods:

- Use the Who Active Dialog Box to Upload, page 59
- Use the Controller Status Menu to Upload, page 60

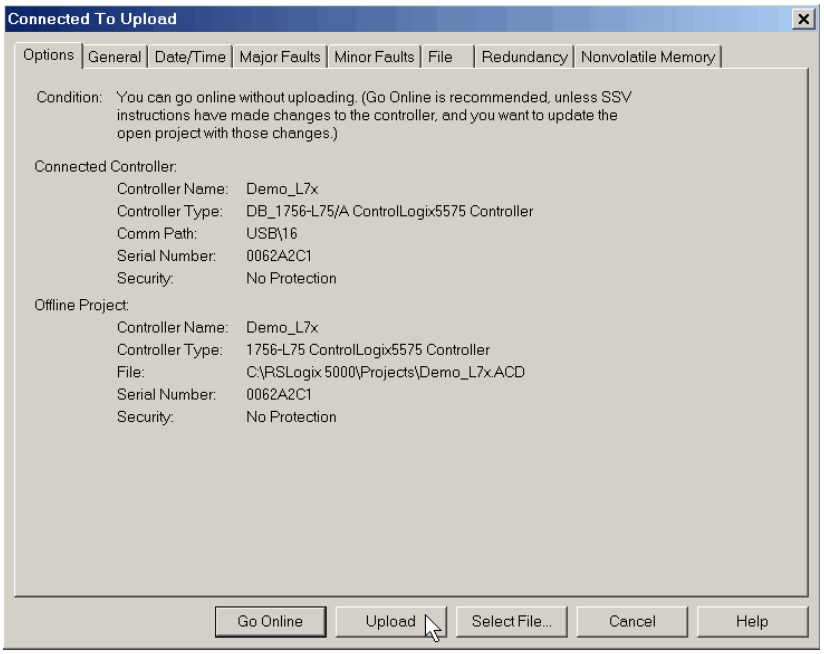
Use the Who Active Dialog Box to Upload

You can use the features of the Who Active dialog box to upload from your controller after you have set the communication path. Complete these steps to upload from the controller.

1. After setting the communication path, click Upload in the Who Active dialog box.



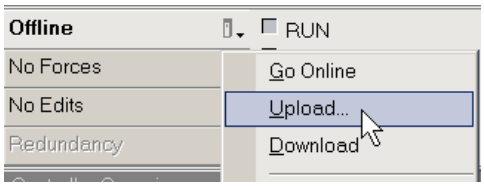
2. Click Upload after verifying the project you are uploading in the Connected to Upload dialog box.



Use the Controller Status Menu to Upload

After you have set a communication path in the project, you can use the Controller Status menu to upload from the controller. To upload, from the Controller Status menu, choose Upload.

Figure 5 - Upload via the Controller Status Menu



Choose the Controller Operation Mode

Use this table as a reference when determining your controller Operation mode.

Table 5 - Controller Operation Modes and Meanings

If you want to	Select one of these modes				
	Run	Remote			Program
		Run	Test	Program	
Turn outputs to the state commanded by the logic of the project	X	X			
Turn outputs to their configured state for Program mode			X	X	X
Execute (scan) tasks	X	X	X		
Change the mode of the controller via Logix Designer application		X	X	X	
Download a project		X	X	X	X
Schedule a ControlNet network				X	X
While online, edit the project		X	X	X	X
Send messages	X	X	X		
Send and receive data in response to a message from another controller	X	X	X	X	X
Produce and consume tags	X	X	X	X	X

Use the Mode Switch to Change the Operation Mode

Use the mode switch to change the operation mode. The controller mode switch provides a mechanical means to enhance controller and control system security. You must physically move the controller's mode switch to change its operating mode from RUN, to REM, or to PROG. When the controller's mode switch is set to RUN mode, features like online editing, program downloads, and firmware upgrades will be prohibited. See Table 5 for a complete list of prohibited features.

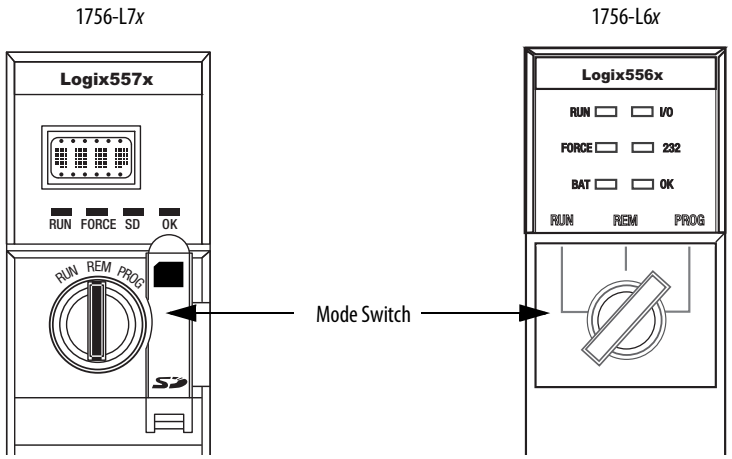
The physical mode switch can complement other authorization and authentication methods that similarly control user-access to the controller, such as the following:

- Logix CPU Security tool
- FactoryTalk Security service

IMPORTANT During runtime, we recommend that you place the controller mode switch in RUN mode and remove the key (if applicable) from the switch. This can help discourage unauthorized access to the controller or potential tampering with the controller's program, configuration, or device firmware. Place the mode switch in REM or PROG mode during controller commissioning and maintenance and whenever temporary access is necessary to change the product's program, configuration, or firmware.

The mode switch on the front of the controller can be used to change the controller to one of these modes:

- Run (RUN)
- Remote (REM)
- Program (PROG)



Mode Switch Position	Available Controller Modes	ATTENTION:
RUN	**Run mode**—The controller is actively controlling the process/machine. Projects cannot be edited in the Logix Designer application when in Run mode.	Run mode should only be used when all conditions are safe.
REM	**Remote Run mode**—This mode is identical to Run mode except you can edit the project online.	Users are able to modify a project file online in Remote Run mode. Be sure to control outputs with care to avoid injury to personnel and damage to equipment.
	Remote Program mode—This mode is identical to Program mode.	
	Remote Test mode—The controller mode during which code is executing. I/O is not controlled, and limited editing operations are available. Output modules are commanded to their Program mode state (on, off, or hold).	Outputs are commanded to their Program mode state, which could cause a dangerous situation.
	Note: The mode of the controller can be changed from within the Logix Designer application.	
PROG	**Program mode**—The controller mode during which programming language is not executing. I/O is not controlled, and limited editing operations are available. Output modules are commanded to their Program mode state (On, Off, or Hold). In this position, controller modes cannot be changed through the Logix Designer application.	Do not use Program mode as an emergency stop (E-stop). Program mode is not a safety device. Outputs are commanded to their Program mode state, which could cause a dangerous situation.

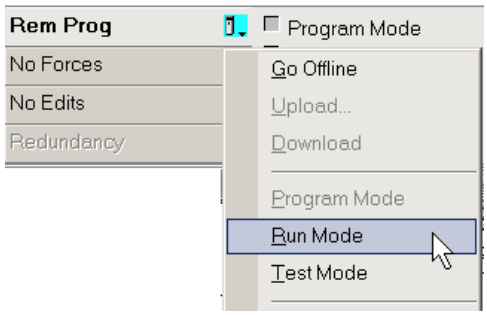
Use Logix Designer to Change the Operation Mode

Depending on the mode of the controller you specify by using the mode switch, you can change the Operation mode of the controller in the Logix Designer application.

After you are online with the controller and the controller mode switch is set to Remote (REM or the center position), you can use the Controller Status menu in the upper-left corner of the application window to specify these operation modes:

- Remote Program
- Remote Run
- Remote Test

Figure 6 - Operation Mode



TIP For this example, the controller mode switch is set to Remote mode. If your controller mode switch is set to Run or Program modes, the menu options change.

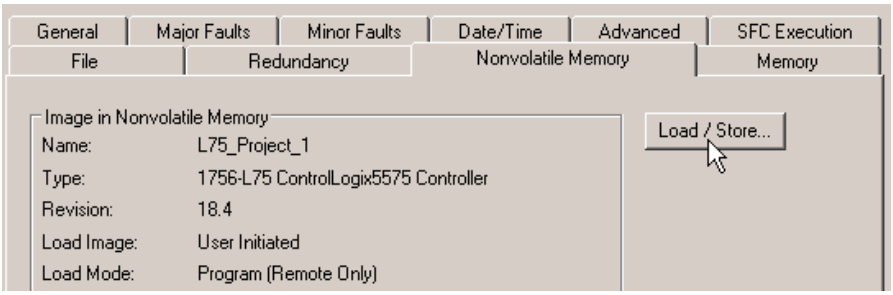
Load or Store to the Memory Card

The memory card that is compatible with your ControlLogix controller is used to load or store the contents of user memory for the controller.

Store to the Memory Card

After you are online with the controller and have changed the controller to Program or Remote Program mode, complete these steps to store a project to the memory card.

1. Open the Controller Properties dialog box and click the Nonvolatile Memory tab.
2. Click Load/Store.



TIP If Load/Store is dimmed (unavailable), verify the following:

- You have specified the correct communication path and are online with the controller in Program mode.
- The memory card is installed.
- With the 1756-L7*x* controllers, if the SD card is locked, Store is dimmed (unavailable) and the locked status is indicated in the bottom-left corner of the Nonvolatile memory/Load Store dialog box. See step 4.

If the memory card is not installed, the missing card is indicated by a message in the lower-left corner of the Nonvolatile Memory tab as shown here.

3. Change the Load Image, Load Mode, and Automatic Firmware Update properties according to your application requirements.

The table below describes the Load Image options you can choose for the project.

IMPORTANT If the SD card is locked and the stored project's Load Image option is set to On Power Up, the controller firmware is not updated as a result of conducting a firmware upgrade. The previously-stored firmware and project are loaded instead.

If you want the image (project) to load when	Then choose
Power to the controller is applied or cycled	On Power Up
The controller has lost the project and power has been cycled or applied	On Corrupt Memory
Initiated via the Logix Designer application	User Initiated

The table below describes the Load Mode options you can choose for the project.

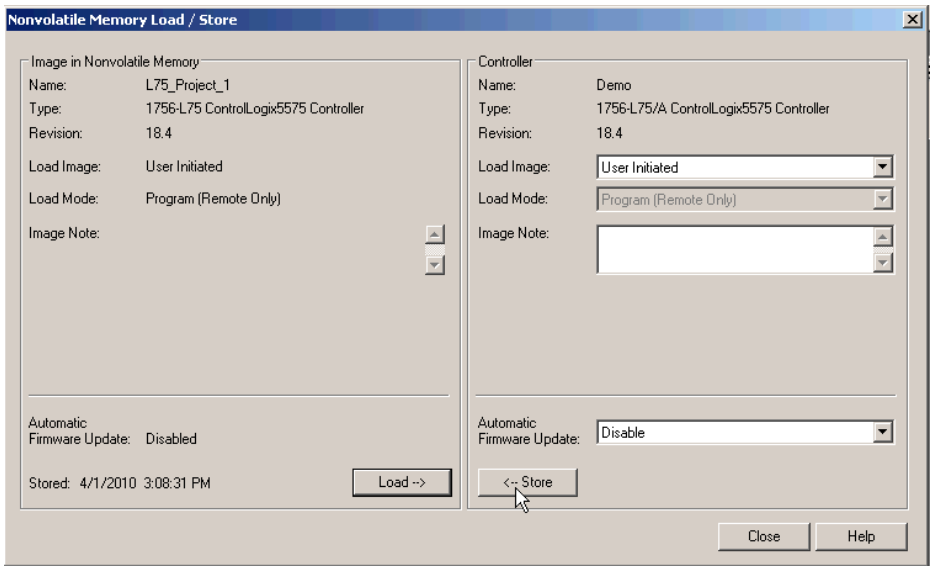
If you want the controller to go to this mode after loading	Then choose
Program	Program (remote only)
Run	Run (remote only)

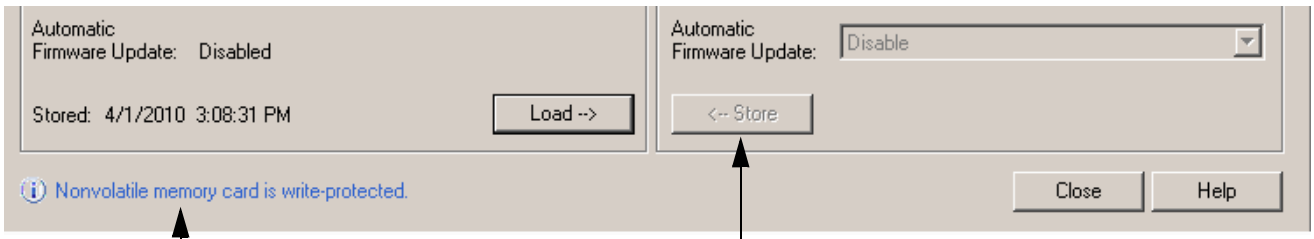
The table below describes the Automatic Firmware Update options you can choose for the project. The Automatic Firmware Update property is also referred to as the Firmware Supervisor feature.

If you want to	Then choose
Enable automatic firmware updates so I/O devices in the configuration tree of the controller that are configured to use Exact Match Keying are updated as required	Enable and Store Files to Image(1)
Disable automatic firmware updates and remove any I/O firmware files that are stored with the image	Disable and Delete Files from Image
Disable automatic firmware updates when there are no firmware files are stored with the image	Disable

(1) The devices used with this option must support the version of firmware being updated to.

4. Click Store, then click OK in the confirmation dialog box that appears.





After clicking Store, the project is saved to the memory card as indicated by the controller status indicators.

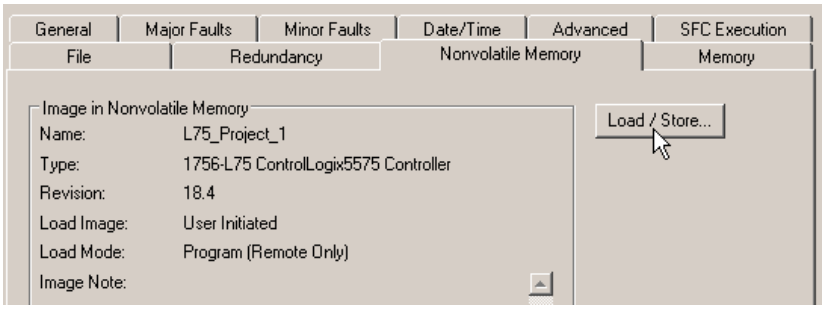
With these controllers	These indications show the store status
1756-L6*x*	While the store is **in progress**, the following occurs: • OK indicator on the controller is solid red • A dialog box in the Logix Designer application indicates the store is in progress When the store is **complete**, the following occurs: • OK indicator on the controller is momentarily red, then solid green
1756-L7*x*	While the store is **in progress**, the following occurs: • OK indicator is flashing green • SD indicator is flashing green • SAVE is shown on the status display • A dialog box in the Logix Designer application indicates the store is in progress When the store is **complete**, the following occurs: • OK indicator on the controller is momentarily red, then solid green • SD indicator on the controller is Off

IMPORTANT Allow the store to complete without interruption. If you interrupt the store, data corruption or loss may occur.

Load from the Memory Card

After you have set the communication path, are online with the controller, and have changed the controller to Program mode, complete these steps to load a project to the controller from the memory card.

1. Open the Controller Properties and click the Nonvolatile Memory tab.
2. Click Load/Store.



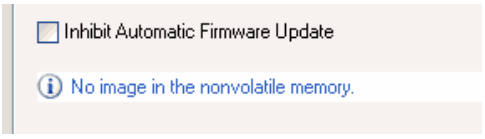
TIP If Load/Store is dimmed (unavailable), verify the following:

- You have specified the correct communication path and are online with the controller.
- The memory card is installed.

If the memory card is not installed, the missing card is indicated by a message in the lower-left corner of the Nonvolatile Memory tab as shown here.

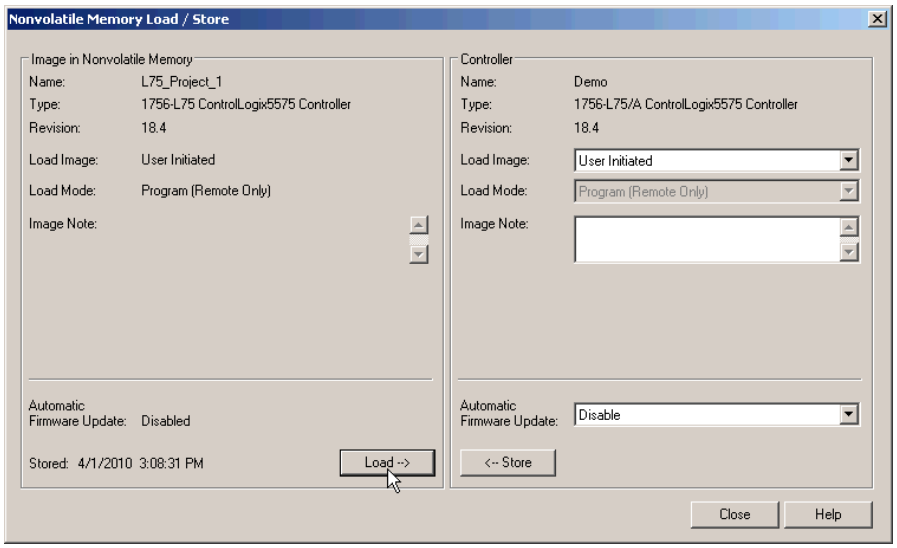
3. Verify that the image in nonvolatile memory (that is, the project on the memory card) is the project you want to load.

TIP If no project is stored on the memory card, a message in the lower-left corner of the Nonvolatile Memory tab indicates that an image (or project) is not available as shown here.



TIP For information about changing the project that is available to load from nonvolatile memory, see the Logix5000™ Controllers Nonvolatile Memory Programming Manual, publication 1756-PM017.

4. Click Load.



After clicking Load, the project is loaded to the controller as indicated by the controller status indicators.

With these controllers	These indications show the store status
1756-L6*x*	While the **load is in progress**, the following occurs: • OK indicator on the controller is flashing green • A dialog box in the Logix Designer application indicates the store is in progress When the **load is complete**, the following occurs: • OK indicator on the controller is momentarily red, then solid green
1756-L7*x*	While the **load is in progress**, the following occurs: • OK indicator is solid red • SD indicator is flashing green • LOAD is shown on the status display • UPDT may be shown on the status display if the firmware is also updating with the load • A dialog box in the Logix Designer application indicates the store is in progress When the **load is complete**, the following occurs: • OK indicator on the controller is momentarily red, then solid green • SD indicator on the controller is Off

IMPORTANT Allow the load to complete without interruption. If you interrupt the load, data corruption or loss may occur.

Other Memory Card Tasks

Other tasks that you may need to complete by using the memory cards of the controller include the following:

- Changing the image that is loaded from the card
- Checking for a load that was completed
- Clearing an image from the memory card
- Storing an empty image
- Changing load parameters
- Reading/writing application data to the card

For more information about completing any of these tasks, see the Logix5000 Controllers Memory Card Programming Manual, publication 1756-PM017.

Use ControlLogix Energy Storage Modules (ESMs)

You can use the ControlLogix ESMs to execute either of the following tasks:

- Provide power to 1756-L7*x* controllers to save the program to the controller's on-board nonvolatile storage (NVS) memory after power is removed from the chassis or the controller is removed from a powered chassis.

IMPORTANT	When you are using an ESM to save the program to on-board NVS memory, you are **not** saving the program to the SD card installed in the controller.

- Clear the program from the 1756-L7*x* controller's on-board NVS memory. For more information, see Clear the Program from On-board NVS Memory.

The following table describes the ESMs.

Cat. No.	Description
1756-ESMCAP	Capacitor-based ESM The 1756-L7*x* controllers come with this ESM installed.
1756-ESMNSE	Capacitor-based ESM without WallClockTime back-up power Use this ESM if your application requires that the installed ESM deplete its residual stored energy to 40µjoules or less before transporting it into or out of your application. Additionally, you can use this ESM with a 1756-L73 (8MB) or smaller memory-sized controller only.
1756-ESMNRM	Secure capacitor-based ESM (non-removable) This ESM provides your application an enhanced degree of security by preventing physical access to the USB connector and the SD card.

Save the Program to On-board NVS Memory

Follow these steps to save the program to NVS memory when the controller loses power.

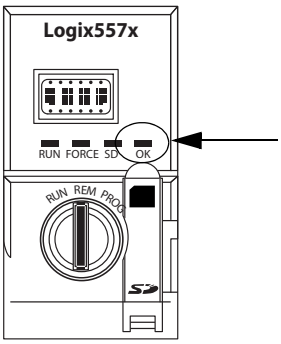
1. Remove power from the controller.

   You can remove power in either of two ways:

   - Turn power off to the chassis while the controller is installed in the chassis.
   - Remove the controller from a powered chassis.

   Immediately after the controller is no longer powered, the program starts saving while the OK status indicator is green (this green is a dimmer green than normal operation), then turns red after program save is complete. Once the ESM stops operating, it turns off.

   The following graphic shows the controller's OK status indicator.



2. Leave the ESM on the controller until the OK status indicator is Off.

Clear the Program from On-board NVS Memory

If your application allows it, follow these steps to clear the program from the 1756-L7*x* controller's on-board NVS memory.

1. Remove the ESM from the controller.
2. Remove power from the controller.

   You can remove power in either of the following two ways:
   - Turn power off to the chassis while the controller is installed in the chassis.
   - Remove the controller from a powered chassis.
3. Reinstall the ESM into the controller.
4. Restore power to the controller in one of these two ways:
   - If the controller is already installed in the chassis, turn power back onto the chassis.
   - If the controller is not installed into the chassis, reinstall the controller into the chassis and turn power back onto the chassis.

Estimate the ESM Support of the WallClockTime

The ESM provides support for the maintenance of the WallClockTime of the controller when power is not applied. Use this table to estimate the hold-up time of the ESM based on the temperature of the controller and installed ESM.

	Hold-up Time (in days)		
Temperature	**1756-ESMCAP**	**1756-ESMNRM**	**1756-ESMNSE**
20 °C (68 °F)	12	12	0
40 °C (104 °F)	10	10	0
60 °C (140 °F)	7	7	0

IMPORTANT Any action causing the 1756-L7*x* controller to reset (hard or soft), without an ESM installed, will result in the controller's wall clock time being reset to the factory default of 01/01/1998.

To check the status of the ESM, refer to General Status Messages on page 186.

Maintain the Battery (1756-L6*x* controllers only)

This section explains how to monitor and maintain the lithium batteries supported by ControlLogix controllers.

Table 6 - 1756-L6*x* Controllers and Compatible Batteries

Cat. No.	Series	Compatible Battery
1756-L61 1756-L62 1756-L63	A	1756-BA1 **or** 1756-BATA **or** 1756-BATM
1756-L61 1756-L62 1756-L63 1756-L64 1756-L65	B	1756-BA2
1756-L63XT	B	

For additional resources, see the table below.

Table 7 - Additional Resources for Battery Maintenance

Resource	Description
Guidelines for Handling Lithium Batteries, publication AG-5.4	Provides information regarding storage, handling, transportation, and disposal of lithium batteries.
Programmable Controllers Battery Reference, http://www.ab.com/programmablecontrol/batteries.html	Provides Material Safety Data Sheets (MSDS) for individual replacement batteries.

Check the Battery Status

When the battery is approximately 95% discharged, these low-battery warnings are indicated:

- The BAT is solid red.
- A minor fault (type 10, code 10) is logged.

IMPORTANT: To prevent possible battery leakage, even if the BAT status indicator is off, replace a battery according to this schedule.

If the temperature 2.54 cm (1 in.) below the chassis is	Replace the battery within
-25…35 °C (-13…95 °F)	No replacement required
36…40 °C (96.8…104 °F)	3 years
41…45 °C (105.8…113 °F)	2 years
46…50 °C (114.8…122 °F)	16 months
51…55 °C (123.8…131 °F)	11 months
56…70 °C (132.8…158 °F)	8 months

1756-BA1 or 1756-BATA Battery Life

To estimate how long a 1756-BA1 or 1756-BATA battery will support controller memory on 1756-L6*x*, series A controllers, perform this procedure.

1. Determine the temperature 2.54 cm (1 in.) below the chassis.
2. Determine the weekly percentage of time that the controller is turned on.

EXAMPLE If a controller is Off **either** one of these times:

- 8 hr/day during a 5-day work week
- All day Saturday and Sunday

Then the controller is off 52% of the time:

- Total hours per week = 7 x 24 = 168 hrs
- Total off hours per week = (5 days x 8 hr/day) + Saturday + Sunday = 88 hrs
- Percentage off time = 88/168 = 52%

3. Determine the estimated worst-case battery life before and after the BAT status indicator turns on.
4. For each year of battery life, decrease the time before the BAT status indicator turns on by the percentage that is shown in the table.

   Do not decrease the time after the BAT status indicator turns on.

IMPORTANT If the BAT status indicator turns on when you apply power to the controller, the remaining battery life may be less than this table indicates. Some of the battery life may have been used up while the controller was off and unable to turn on the BAT status indicator.

Table 8 - Worst-case Estimates of 1756-BA1 Battery Life

Temperature	Battery Life Before BAT Status Indicator Turns On			Battery Life after BAT Status Indicator Turns On and Power is Off
	Power Off 100%	Power Off 50%	Yearly Decrease	
60 °C (140 °F)	22 days	43 days	23%	6 hrs
25 °C (77 °F)	21 days	42 days	17%	28 hrs
0 °C (32 °F)	14 days	28 days	17%	2.5 days

Table 9 - Worst-case Estimates of 1756-BATA Battery Life

Temperature	Battery Life Before BAT Status Indicator Turns On			Battery Life after BAT Status Indicator Turns On and Power is Off
	Power Off 100%	Power Off 50%	Yearly Decrease	
60 °C (140 °F)	98 days	204 days	11%	104 days
25 °C (77 °F)	146 days	268 days	5%	157 days
0 °C (32 °F)	105 days	222 days	6%	113 days

1756-BATM Battery Module and Battery Life

Use the 1756-BATM battery module with any 1756-L6*x*/A controller. The battery module is highly recommended for higher-memory controllers.

IMPORTANT If your project is not stored in nonvolatile memory, the use of the battery module is highly recommended.

When the 1756-BATA battery within the 1756-BATM module is approximately 50% discharged, these low-battery warnings are indicated:

- The BAT is solid red.
- A minor fault (type 10, code 10) is logged.

Estimate 1756-BA2 Battery Life

The 1756-BA2 batteries are for use in 1756-L6*x*/B controllers. Use this table to estimate how much time will elapse before the battery becomes low.

Table 10 - Worst-case Estimates of 1756-BA2 Life According to Temperatures and Power Cycles

Temperature 2.54 cm (1 in.) Below the Chassis, max	Power Cycles	Battery Life Before the BAT Status Indicator Turns Red				
		Project Size				
		1 MB	2 MB	4 MB	8 MB	16 MB
-25…35 °C (-13…95 °F)	3 per day	3 years	3 years	26 months	20 months	10 months
	2 per day or less	3 years	3 years	3 years	31 months	16 months
41...45 °C (105.8...113 °F)	3 per day	2 years	2 years	2 years	20 months	10 months
	2 per day or less	2 years	2 years	2 years	2 years	16 months
46...50 °C (105.8...113 °F)	3 per day or less	16 months	16 months	16 months	16 months	10 months
51...55 °C (123.8...131 °F)	3 per day or less	11 months	11 months	11 months	11 months	10 months
56…70 °C (132.8…158 °F)	3 per day or less	8 months	8 months	8 months	8 months	8 months

Estimate 1756-BA2 Battery Life after Warnings

Use this table to estimate the battery life after the low-battery warnings are indicated. Use these times even if the controller does not have power because there is always a small power-drain on the battery.

IMPORTANT When you power up the controller, see if there is a low-battery warning. If you get a low-battery warning for the first time, you have less battery life than this table shows. While powered down, the controller still drains the battery but it cannot give the low-battery warning.

Temperature 2.54 cm (1 in.) Below the Chassis, max	Power Cycles	Battery Life After the BAT Status Indicator Turns Red (worst case)				
		Project Size				
		1 MB	2 MB	4 MB	8 MB	16 MB
0...20 °C (32...68 °F)	3 per day	26 weeks	18 weeks	12 weeks	9 weeks	5 weeks
	1 per day	26 weeks	26 weeks	26 weeks	22 weeks	13 weeks
	1 per month	26 weeks	26 weeks	26 weeks	26 weeks	26 weeks
21...40 °C (69.8...104 °F)	3 per day	18 weeks	14 weeks	10 weeks	8 weeks	5 weeks
	1 per day	24 weeks	21 weeks	18 weeks	16 weeks	11 weeks
	1 per month	26 weeks	26 weeks	26 weeks	26 weeks	26 weeks
41...45 °C (105.8...113 °F)	3 per day	12 weeks	10 weeks	7 weeks	6 weeks	4 weeks
	1 per day	15 weeks	14 weeks	12 weeks	11 weeks	8 weeks
	1 per month	17 weeks	17 weeks	17 weeks	17 weeks	16 weeks
46...50 °C (105.8...113 °F)	3 per day	10 weeks	8 weeks	6 weeks	6 weeks	3 weeks
	1 per day	12 weeks	11 weeks	10 weeks	9 weeks	7 weeks
	1 per month	12 weeks	12 weeks	12 weeks	12 weeks	12 weeks
51...55 °C (123.8...131 °F)	3 per day	7 weeks	6 weeks	5 weeks	4 weeks	3 weeks
	1 per day	8 weeks	8 weeks	7 weeks	7 weeks	5 weeks
	1 per month	8 weeks	8 weeks	8 weeks	8 weeks	8 weeks
56...60 °C (132.8...140 °F)	3 per day	5 weeks	5 weeks	4 weeks	4 weeks	2 weeks
	1 per day	6 weeks	6 weeks	5 weeks	5 weeks	4 weeks
	1 per month	6 weeks	6 weeks	6 weeks	6 weeks	6 weeks

EXAMPLE Under these conditions, the battery will last at least 20 months before the BAT status indicator turns red:

- The maximum temperature 2.54 cm (1 in.) below the chassis = 45 °C (113 °F).
- You cycle power to the controller three times per day.
- The controller contains an 8 MB project.

Battery Storage and Disposal

Follow these general rules to store your batteries:

- Store batteries in a cool, dry environment. We recommend 25 °C (77 °F) with 40…60% relative humidity.
- You may store batteries for up to 30 days in temperatures from -45...85 °C (-49...185 °F), such as during transportation.
- To avoid leakage or other hazards, do not store batteries above 60 °C (140 °F) for more than 30 days.

This product contains a sealed lithium battery that needs to be replaced during the life of the product.

At the end of its life, the battery contained in this product should be collected separately from any unsorted municipal waste.

The collection and recycling of batteries helps protect the environment and contributes to the conservation of natural resources as valuable materials are recovered.

ControlLogix System and Controllers

Topic	Page
ControlLogix System	77
Design a ControlLogix System	80
ControlLogix Controller Features	81

ControlLogix System

The ControlLogix system is chassis-based and provides the option to configure a control system that uses sequential, process, motion, and drive control in addition to communication and I/O capabilities.

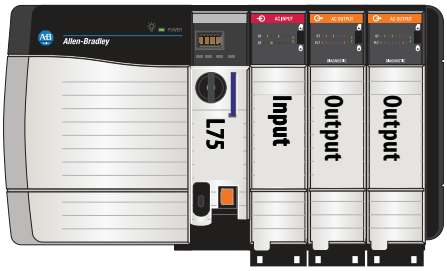
Configuration Options

This section describes some of the many system configuration options that are available with ControlLogix controllers.

Standalone Controller and I/O

One of the simplest ControlLogix configurations is a standalone controller with I/O assembled in one chassis.

Figure 7 - Standalone Controller and I/O



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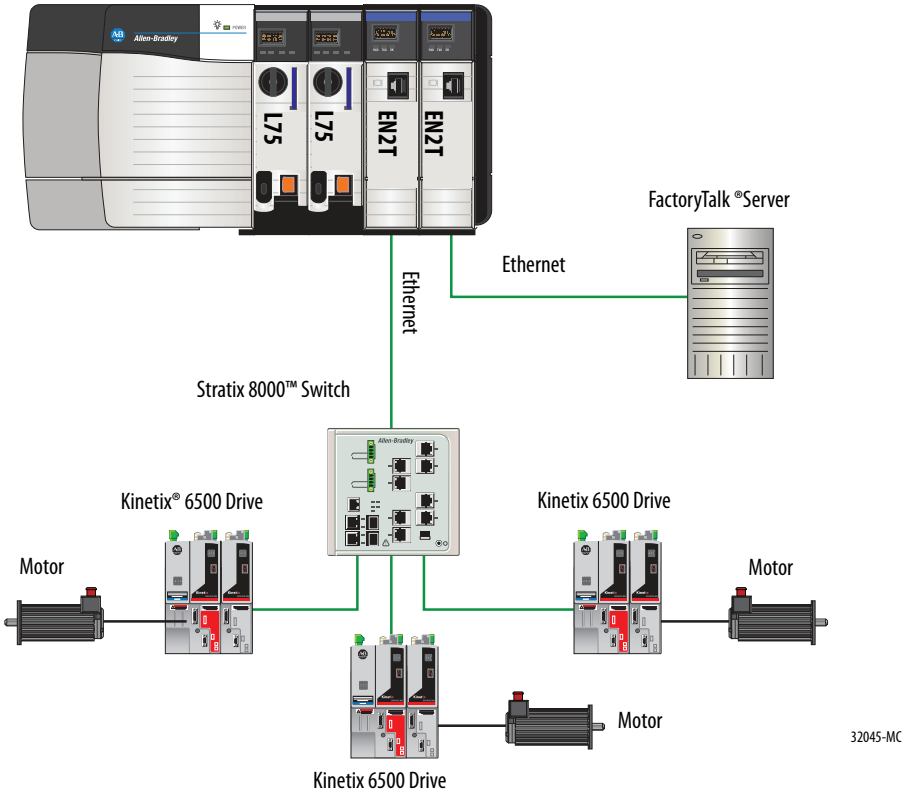
Multiple Controllers in One Chassis

For some applications, multiple controllers may be used in one ControlLogix chassis. For example, for better performance, multiple controllers can be used in motion applications.

Figure 8 - Multiple Controllers in One Chassis

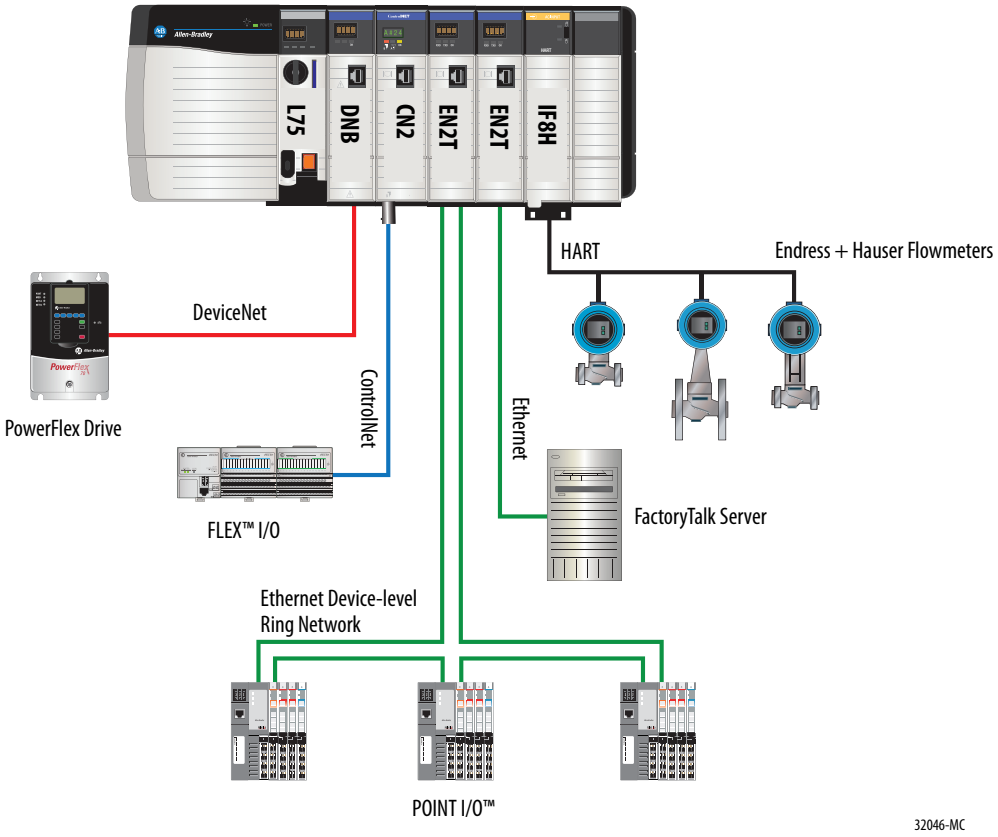


Multiple Devices Connected via Multiple Networks

For some applications, a variety of devices may be connected to the ControlLogix chassis via multiple communication networks. For example, a system might be connected to the following:

- Distributed I/O via an Ethernet network
- A PowerFlex® drive connected via a DeviceNet network
- Flowmeters connected via a HART connection

Figure 9 - Multiple Devices Connected via Multiple Networks



Design a ControlLogix System

When you design a ControlLogix system, there are several system components to consider for your application. Some of these components include the following:

- I/O devices
- Motion control and drive requirements
- Communication modules
- Controllers
- Chassis
- Power supplies
- Studio 5000 environment

For more information about designing and selecting components for your ControlLogix system, see the ControlLogix Selection Guide, publication 1756-SG001.

In addition, if you are designing your ControlLogix System for any of the specific applications listed in this table, see the appropriate resources for more information.

For this type of application	See this publication
Motion with Integrated Motion on the EtherNet/IP network	Integrated Motion on the EtherNet/IP Network Configuration and Startup User Manual, publication MOTION-UM003
Motion with the use of a coordinate system	Motion Coordinated Systems User Manual, publication MOTION-UM002
Motion with Sercos or analog motion	SERCOS Motion Configuration and Startup User Manual, publication MOTION-UM001
Enhanced redundancy	ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535
Standard redundancy	ControlLogix Redundancy System User Manual, publication 1756-UM523
SIL2	Using ControlLogix in SIL2 Applications Safety Reference Manual, publication 1756-RM001
SIL2 fault-tolerant I/O with RSLogix 5000 subroutines	ControlLogix SIL2 System Configuration Using RSLogix 5000 Subroutines Application Technique, publication 1756-AT010
SIL2 fault-tolerant I/O with RSLogix 5000 Add-On Instructions	ControlLogix SIL2 System Configuration Using SIL2 Add-On Instructions Application Technique, publication 1756-AT012

ControlLogix Controller Features

The ControlLogix controllers are part of the Logix5000 family of controllers offered by Rockwell Automation. The sections that follow describe the differentiating features of the ControlLogix controllers.

System, Communication, and Programming Features

This table lists the system, communication, and programming features available with ControlLogix controllers.

Table 11 - ControlLogix Controller Features

Feature	1756-L61, 1756-L62, 1756-L63, 1756-L64, 1756-L65	1756-L71, 1756-L72, 1756-L73, 1756-L74, 1756-L75
Controller tasks	• 32 tasks • 100 programs/task • Event tasks: all event triggers	
Communication ports	1 port - RS-232 serial	1 port - USB, 2.0 full-speed, Type B
Communication options	• EtherNet/IP • ControlNet • DeviceNet • Data Highway Plus™ • Remote I/O • SynchLink • Third-party process and device networks	
Serial port communication	• ASCII • DF1 full/half-duplex • DF1 radio modem • DH-485 • Modbus via logic	N/A
Controller connections supported, max	250	500
Network connections, per network module	• 100 ControlNet (1756-CN2/A) • 40 ControlNet (1756-CNB) • 256 EtherNet/IP; 128 TCP (1756-EN2*x*) • 128 EtherNet/IP; 64 TCP (1756-ENBT)	
Controller redundancy	Full support except for motion applications	
Integrated motion	• Integrated Motion on the EtherNet/IP network • SERCOS interface • Analog options: – Encoder input – LDT input – SSI input	
Programming languages	• Relay ladder • Structured text • Function block • Sequential Function Chart (SFC)	

Memory Options

The ControlLogix controller is available in different combinations of user memory. Use this table to determine which controller meets your memory requirements.

Table 12 - ControlLogix Controller Memory Options

Controller	Memory for Data and Logic	I/O	Back-up Memory
1756-L61	2 MB	478 KB	CompactFlash card(1)
1756-L62	4 MB		
1756-L63, 1756-L63XT	8 MB		
1756-L64	16 MB		
1756-L65	32 MB		
1756-L71	2 MB	0.98 MB (1006 KB)	SD card
1756-L72	4 MB		
1756-L73, 1756-L73XT	8 MB		
1756-L74	16 MB		
1756-L75	32 MB		

(1) These nonvolatile memory cards are optional and do not come with the controller.

IMPORTANT The 1756-L7*x* controllers ship with an SD card installed. We recommend that you leave the SD card installed, so if a fault occurs, diagnostic data is automatically written to the card and can be used by Rockwell Automation to troubleshoot the anomaly.

IMPORTANT We recommend that you use the SD cards available from Rockwell Automation (catalog numbers 1784-SD1 or 1784-SD2).

While other SD cards may be used with the controller, Rockwell Automation has not tested the use of those cards with the controller. If you use an SD card other than those available from Rockwell Automation, you may experience data corruption or loss.

Also, SD cards not provided by Rockwell Automation may not have the same industrial, environmental, and certification ratings as those available from Rockwell Automation and may not survive in the same industrial environments as the industrially rated versions available from Rockwell Automation.

Communication Networks

Topic	Page
Networks Available	83
EtherNet/IP Network Communication	84
ControlNet Network Communication	87
DeviceNet Network Communication	90
Data Highway Plus (DH+) Network Communication	92
Universal Remote I/O (RIO) Communication	94
Foundation Fieldbus Communication	96
HART Communication	97

Networks Available

Several communication networks are available for use with ControlLogix systems. This table describes typical network applications used with ControlLogix systems and lists the networks available to support such applications.

Table 13 - Applications and Supported Networks

Application Type	Supported Networks
Integrated Motion	EtherNet/IP
Integrated Motion on the EtherNet/IP network for time synchronization	EtherNet/IP
Control of distributed I/O	• ControlNet • DeviceNet • EtherNet/IP • Foundation Fieldbus • HART • Universal remote I/O
Produce/consume data between controllers	• ControlNet • EtherNet/IP
Messaging to and from other devices, including access to the controller via Logix Designer application	• ControlNet • DeviceNet (only to devices) • Data Highway Plus (DH+) • DH-485 • EtherNet/IP • Serial

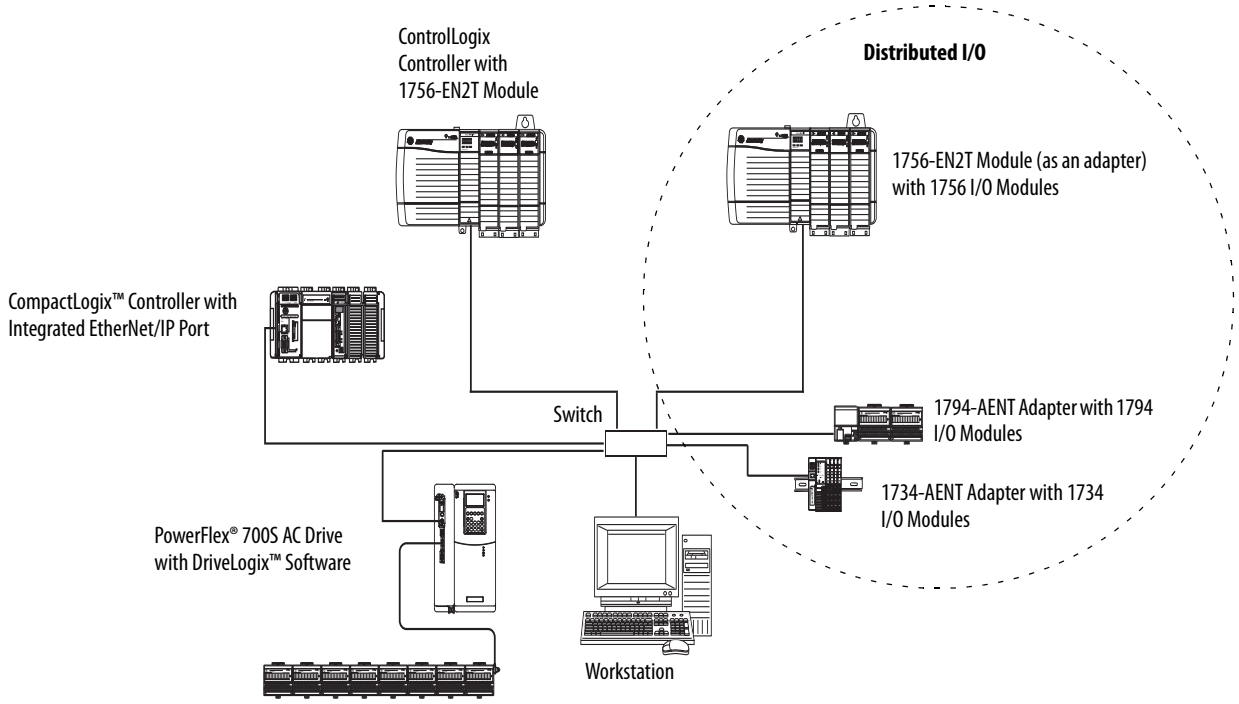
For additional information about network design for your system, see the Ethernet Design Considerations Reference Manual, publication ENET-RM002.

EtherNet/IP Network Communication

The EtherNet/IP network offers a full suite of control, configuration, and data collection services by layering the Common Industrial Protocol (CIP) over the standard Internet protocols, such as TCP/IP and UDP. This combination of well-accepted standards provides the capability required to both support information data exchange and control applications.

The EtherNet/IP network uses commercial, off-the-shelf Ethernet components and physical media, providing you with a cost-effective plant-floor solution.

Figure 10 - EtherNet/IP Network Example



For more information about using EtherNet/IP modules, see the EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

ControlLogix EtherNet/IP Module Features

The ControlLogix EtherNet/IP communication modules provide these features:

- Support for messaging, produced/consumed tags, HMI, and distributed I/O
- The ability to encapsulate messages within the standard TCP/UDP/IP protocol
- A common application layer with ControlNet and DeviceNet networks
- Network connections via an RJ45 cable
- Support half/full duplex 10 MB or 100 MB operation
- Support standard switches

ControlLogix EtherNet/IP Communication Modules

For EtherNet/IP network communication in a ControlLogix system, you have several modules to choose from. This table lists modules and their primary features.

Table 14 - EtherNet/IP Communication Modules and Capabilities

Module	Is used to
1756-ENBT	• Connect controllers to I/O modules (requires an adapter for distributed I/O). • Communicate with other EtherNet/IP devices (messages). • Serve as a pathway for data sharing between Logix5000 controllers (produce/consume). • Bridge EtherNet/IP nodes to route messages to devices on other networks.
1756-EN2T	• Perform the same functions as a 1756-ENBT module, with twice the capacity for more demanding applications. • Provide a temporary configuration connection via the USB port. • Configure IP addresses quickly by using rotary switches.
1756-EN2F	• Perform the same functions as a 1756-EN2T module. • Connect fiber media by an LC fiber connector on the module.
1756-EN2TR	• Perform the same functions as a 1756-EN2T module. • Support communication on a ring topology for a Device Level Ring (DLR) single-fault tolerant ring network.
1756-EN3TR	• Perform the same functions as the 1756-EN2TR module. • Extended Integrated Motion on EtherNet/IP network. • Support of up to 128 motion axes.
1756-EN2TXT	• Perform the same functions as a 1756-EN2T module. • Operate in extreme environments with -25…70 °C (-13…158 °F) temperatures.
1756-EWEB	• Provide customizable web pages for external access to controller information. • Provide remote access via an Internet browser to tags in a local ControlLogix controller. • Communicate with other EtherNet/IP devices (messages). • Bridge EtherNet/IP nodes to route messages to devices on other networks. • Support Ethernet devices that are not EtherNet/IP-based with a socket interface. This module does not provide support for I/O or produced/consumed tags.

Software for EtherNet/IP Networks

This table lists software that is used with the EtherNet/IP networks and modules.

Table 15 - Software for Use with EtherNet/IP Networks

Software	Is used to	Required or Optional
Logix Designer application	• Configure ControlLogix projects. • Define EtherNet/IP communication.	Required
RSLinx Classic or RSLinx® Enterprise	• Configure communication devices. • Provide diagnostics. • Establish communication between devices.	Required
BOOTP/DHCP Utility	Assign IP addresses to devices on an EtherNet/IP network.	Optional
RSNetWorx™ for EtherNet/IP	• Configure EtherNet/IP devices by IP addresses and/or host names. • Provide bandwidth status.	

Connections over an EtherNet/IP Network

You indirectly determine the number of connections the controller uses by configuring the controller to communicate with other devices in the system. Connections are allocations of resources that provide more reliable communication between devices compared to unconnected messages.

All EtherNet/IP connections are unscheduled. An unscheduled connection is triggered by the requested packet interval (RPI) for I/O control or the program, such as a MSG instruction. Unscheduled messaging lets you send and receive data when needed.

Double Data Rate (DDR) Backplane Communication

DDR communication can be achieved with the 1756-L7*x* controller. The following communication modules support DDR when used in conjunction with the 1756-L7*x* controller. Minimum series are indicated:

- 1756-EN2T/C
- 1756-EN2TR/B
- 1756-EN2TF/B
- 1756-EN2TXT/C
- 1756-EN3TR/A
- 1756-RM/B

DDR communication is achieved most efficiently when all modules in the communication path are DDR modules, or, in other words, as a single conversation (connection) only between DDR modules.

DDR communication is achievable in a chassis with a mix of DDR and non-DDR modules. The DDR communication occurs between the modules that support it. If non-DDR modules are also in the chassis, communication between those modules will be at the non-DDR rate.

For example, you could have a chassis with two 1756-L7*x* controllers in slots 0 and 1 communicating with each other using DDR, and two 1756-L6*x* controllers in slots 2 and 3 communicating using non-DDR.

When multicast communication is used within a chassis to multiple modules, the transmission rate is limited to the slowest module—or at the non-DDR rate.

For example, if a 1756-L7*x* controller is producing a tag to a 1756-L7*x* controller **and** a 1756-L6*x* controller on the same multicast connection, it must use the non-DDR rate.

ControlNet Network Communication

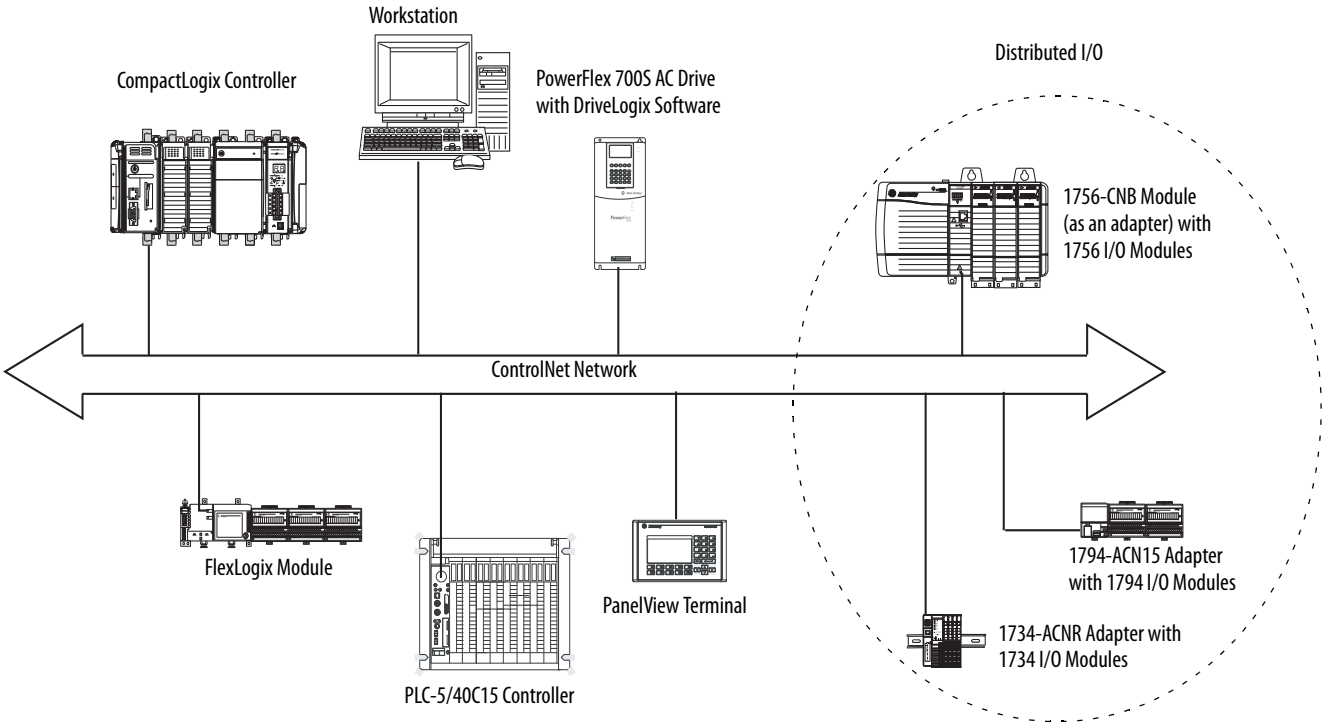
The ControlNet network is a real-time control network that provides high-speed transport of both time-critical I/O and interlocking data and messaging data. This includes uploading and downloading of program and configuration data on a single physical-media link. The ControlNet network's highly-efficient data transfer capability significantly enhances I/O performance and peer-to-peer communication in any system or application.

The ControlNet network is highly deterministic and repeatable and is unaffected when devices are connected or disconnected from the network. This quality results in dependable, synchronized, and coordinated real-time performance.

The ControlNet network often functions as the following:

- A substitute/replacement for the remote I/O (RIO) network because the ControlNet network adeptly handles large numbers of I/O points
- A backbone for multiple distributed DeviceNet networks
- A peer interlocking network

Figure 11 - ControlNet Network Overview



In this example, these actions occur via the ControlNet network:

- The controllers produce and consume tags.
- The controllers initiate MSG instructions that do the following:
  - Send and receive data.
  - Configure devices.
- The workstation is used to do the following:
  - Configure both the ControlNet devices and the ControlNet network.
  - Download and upload projects from the controllers.

For more information about using ControlNet modules, see ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001.

ControlLogix ControlNet Module Features

The ControlNet communication modules provide these features:

- Support for messaging, produced/consumed tags, and distributed I/O
- Use a common application layer with DeviceNet and EtherNet/IP networks
- Requires no routing tables
- Support the use of coax and fiber repeaters for isolation and increased distance
- Support redundant media (1756-CNBR, 1756-CN2R, and 1756-CN2RXT modules only)

ControlLogix ControlNet Modules

This table lists the available ControlLogix ControlNet modules and their primary features.

Table 16 - ControlNet Modules and Capabilities

Module	Is used to
1756-CNB	• Control I/O modules. • Communicate with other ControlNet devices (messages). • Share data with other Logix5000 controllers (produce/consume). • Bridge ControlNet links to route messages to devices on other networks.
1756-CNBR	• Perform the same functions as a 1756-CNB module. • Support redundant ControlNet media.
1756-CN2	• Perform the same functions as a 1756-CNB module. • Provide twice the capacity for more demanding applications.
1756-CN2R	• Perform the same functions as a 1756-CN2 module. • Support redundant ControlNet media.
1756-CN2RXT	• Perform same functions as a 1756-CN2R module. • Operate in extreme environments with -25…70 °C (-13…158 °F) temperatures.

Software for ControlNet Networks

This table lists software that is used with the ControlNet networks and modules.

Table 17 - Software for Use with ControlNet Networks

Software	Is used to	Required or Optional
Logix Designer application	• Configure ControlLogix projects. • Define ControlNet communication.	Required
RSNetWorx™ for ControlNet™	• Configure ControlNet devices. • Schedule a network.	
RSLinx Classic or Enterprise	• Configure communication devices. • Provide diagnostics. • Establish communication between devices.	

Connections over a ControlNet Network

You indirectly determine the number of connections the controller uses by configuring the controller to communicate with other devices in the system. Connections are allocations of resources that provide more reliable communication between devices compared to unconnected messages.

Table 18 - ControlNet Connections

Connection	Definition
Scheduled (unique to a ControlNet network)	A scheduled connection is unique to ControlNet communication. A scheduled connection lets you send and receive data repeatedly at a predetermined interval, which is the requested packet interval (RPI). For example, a connection to an I/O module is a scheduled connection because you repeatedly receive data from the module at a specified interval. Other scheduled connections include connections to the following: • Communication devices • Produced/consumed tags On a ControlNet network, you must use RSNetWorx for ControlNet software to enable all scheduled connections and establish a network update time (NUT). Scheduling a connection reserves network bandwidth specifically to handle the connection.
Unscheduled	An unscheduled connection is a message transfer between devices that is triggered by the requested packet interval (RPI) or the program, such as a MSG instruction. Unscheduled messaging lets you send and receive data when you need to: Unscheduled connections use the remainder of network bandwidth after scheduled connections are allocated.

ControlNet Module Connections

The 1756-CNB and 1756-CNBR communication modules support 64 CIP connections over a ControlNet network. However, for optimal performance, configure a maximum of 48 connections for each module.

The 1756-CN2, 1756-CN2R, and 1756-CN2RXT communication modules support 128 connections over a ControlNet network, all of which can be configured without risk of performance degradation.

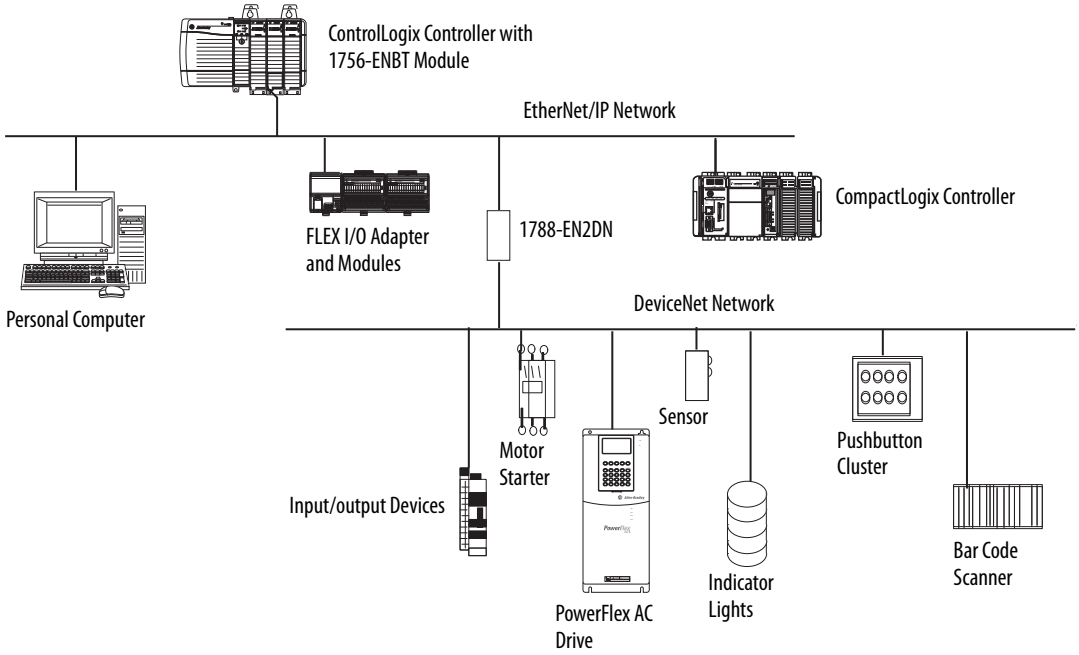
DeviceNet Network Communication

The DeviceNet network uses the Common Industrial Protocol (CIP) to provide the control, configuration, and data collection capabilities for industrial devices. The DeviceNet network uses the proven Controller Area Network (CAN) technology, which lowers installation costs and decreases installation time and costly downtime.

A DeviceNet network provides access to the intelligence present in your devices by letting you connect devices directly to plant-floor controllers without having to hard wire each device into an I/O module.

With a ControlLogix system, DeviceNet communication requires the use of a 1756-DNB DeviceNet communication module.

Figure 12 - ControlLogix DeviceNet Network Overview



In this example, the ControlLogix controller is connected to the DeviceNet network and devices via the 1788-EN2DN linking device.

For more information about using DeviceNet modules and devices, see DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004.

ControlLogix DeviceNet Module Features

The DeviceNet communication module provides these features:

- Supports messaging to devices (not controller to controller)
- Shares a common application layer with ControlNet and EtherNet/IP networks
- Offers diagnostics for improved data collection and fault detection
- Requires less wiring than standard, hard-wired systems

ControlLogix DeviceNet Bridge Module and Linking Devices

This table lists the available ControlLogix DeviceNet bridge module and linking devices that can be used with the DeviceNet network.

Table 19 - DeviceNet Communication Modules and Capabilities

Module/Device	Is used to
1756-DNB	• Control I/O modules. • Communicate with other DeviceNet devices (via messages).
1788-EN2DN	Link an EtherNet/IP network to a DeviceNet network.
1788-CN2DN	Link a ControlNet network to a DeviceNet network.

Software for DeviceNet Networks

This table lists software that is used with the DeviceNet networks and modules.

Table 20 - Software for Use with DeviceNet Networks

Software	Is used to	Required or Optional
Logix Designer application	• Configure ControlLogix projects. • Define DeviceNet communication.	Required
RSNetWorx™ for DeviceNet™	• Configure DeviceNet devices. • Define the scan list for those devices.	
RSLinx Classic or Enterprise	• Configure communication devices. • Provide diagnostics. • Establish communication between devices.	

Connections over DeviceNet Networks

The ControlLogix controller requires two connections for each 1756-DNB module. One connection is for module status and configuration. The other connection is a rack-optimized connection for the device data.

ControlLogix DeviceNet Module Memory

The 1756-DNB module has fixed sections of memory for the input and output data of the DeviceNet devices on the network. Each device on your network requires either some input or output memory of the scanner. Some devices both send and receive data, so they need both input and output memory. The 1756-DNB module supports up to add the following:

- 124 DINTs of input data
- 123 DINTs of output data

Data Highway Plus (DH+) Network Communication

For DH+ network communication, use a 1756-DHRIO module in the ControlLogix chassis to exchange information between these controllers:

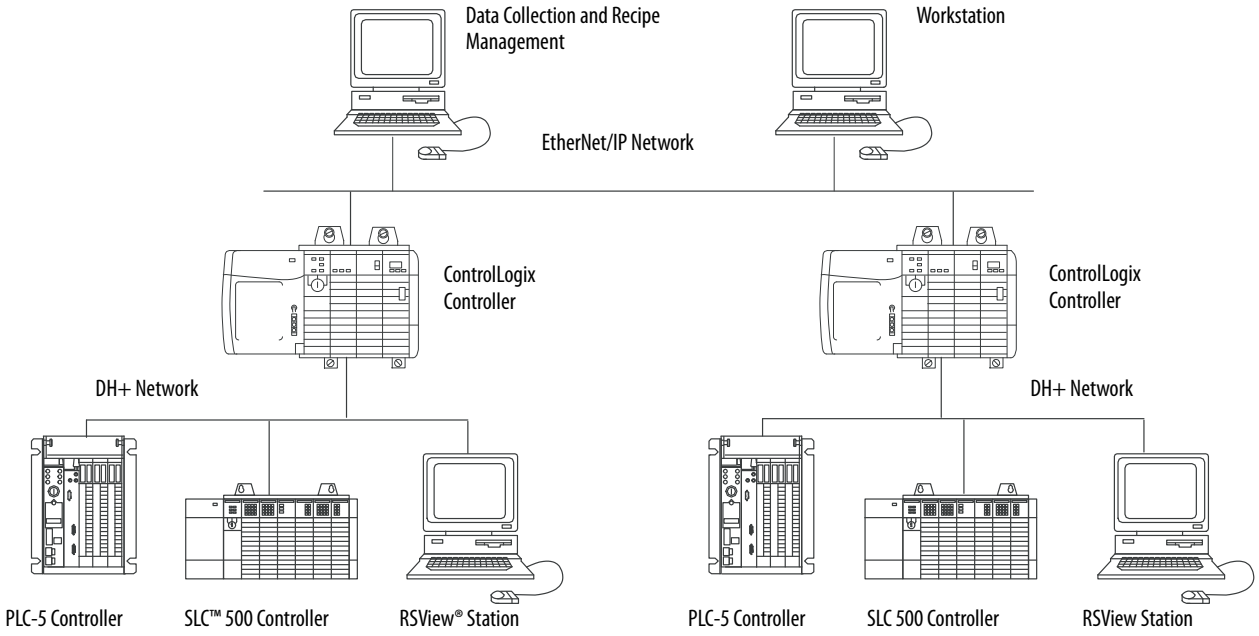
- PLC and SLC controllers
- ControlLogix controllers and PLC or SLC controllers
- ControlLogix controllers

In addition to data exchange between controllers, the DH+ network also provides the ability to regularly share data both plant-wide and at a cellular level.

You can connect a maximum of 32 stations to a single DH+ link:

- Channel A supports 57.6 Kbps, 115.2 Kbps, and 230.4 Kbps.
- Channel B supports 57.6 Kbps and 115.2 Kbps.

Figure 13 - ControlLogix DH+ Network Communication Example



Communicate over a DH+ Network

For the controller to communicate to a workstation or other device over a DH+ network, use RSLinx Classic software to do the following:

- Specify a unique link ID for each ControlLogix backplane and additional network in the communication path.
- Configure the routing table for the 1756-DHRIO module.

The 1756-DHRIO module can route a message through up to four communication networks and three chassis. This limit applies only to the routing of a message and not to the total number of networks or chassis in a system.

For more information about configuring and using a DH+ network via the 1756-DHRIO module, see the Data Highway Plus-Remote I/O Communication Interface Module User Manual, publication 1756-UM514.

Universal Remote I/O (RIO) Communication

For universal remote I/O communication, you have two module options for use in the ControlLogix chassis. This table lists the RIO modules and capabilities.

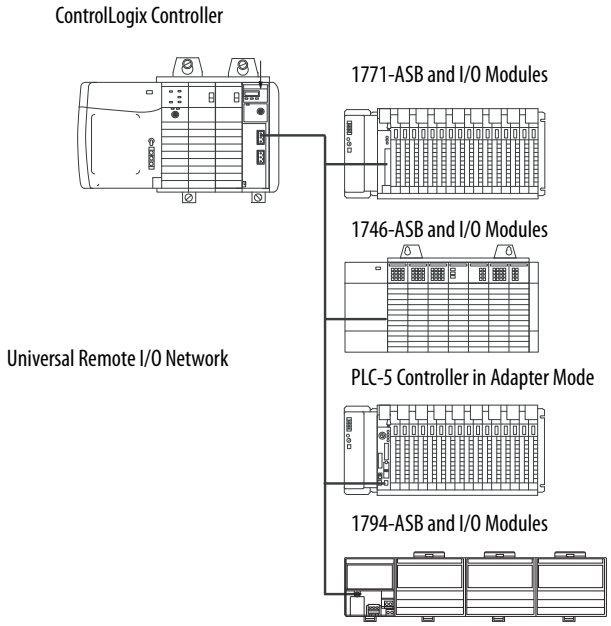
Table 21 - RIO Modules and Capabilities

RIO Module	Is used to
1756-RIO	• Function as an RIO scanner and adapter. • Support connections to 32 racks in any combination of rack size or block transfers. • Update data to the ControlLogix controller by using scheduled connections.
1756-DHRIO	• Function as an RIO scanner. • Support either 32 logical rack connections or 16 block-transfer connections per channel. • Establish connections between controllers and I/O adapters. • Distribute control so that each controller has its own I/O.

When a channel on the 1756-DHRIO module is configured for remote I/O, the module acts as a scanner for a universal remote I/O network. The controller communicates to the module to send and receive the I/O data on the universal remote I/O network.

The 1756-RIO module can act as a scanner or adapter on a remote I/O network. In addition to digital and block-transfer data, the 1756-RIO module transfers analog and specialty data without message instructions.

Figure 14 - ControlLogix Universal Remote I/O Communication Example



Communicate over a Universal Remote I/O Network

For the controller to control I/O over a universal remote I/O network, you must complete these tasks.

1. Configure the remote I/O adapter.
2. Lay out the remote I/O network cable.
3. Connect the remote I/O network cable.
4. Configure the scanner channel.

For more information about configuring a remote I/O network with the 1756-RIO or 1756-DHRIO modules, see these publications:

- Data Highway Plus-Remote I/O Communication Interface Module User Manual, publication 1756-UM514
- ControlLogix Remote I/O Communication Module User Manual, publication 1756-UM534

As you design your remote I/O network, remember the following:

- All devices connected to a remote I/O network must communicate using the same communication rate. These rates are available for remote I/O:
  - 57.6 Kbps
  - 115.2 Kbps
  - 230.4 Kbps
- You must assign unique partial and full racks to each channel used in Remote I/O Scanner mode.

  Both channels of a 1756-DHRIO module cannot scan the same partial or full rack address. Both module channels can communicate to 00...37 octal or 40...77 octal, but each channel can communicate only with one address at a time in whichever of these two ranges it falls.

Foundation Fieldbus Communication

Foundation Fieldbus is an open interoperable fieldbus designed for process control instrumentation. The fieldbus devices described in the table can be connected to the ControlLogix controller via another network as shown in the example below.

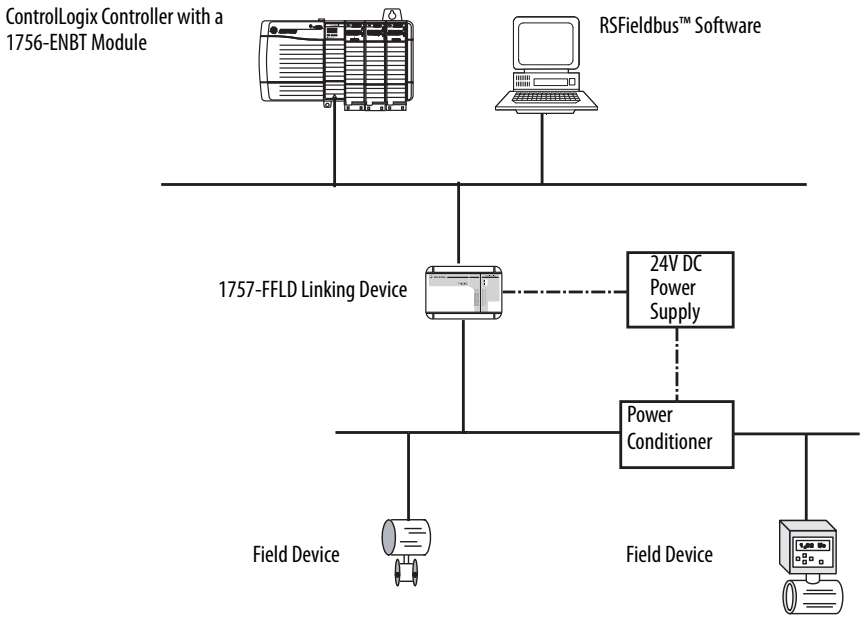
Table 22 - Fieldbus Devices and Capabilities

Fieldbus Device	Is used to
1757-FFLD	• Bridge an EtherNet/IP network to Foundation Fieldbus. • Connect via a low-speed serial (H1) and high-speed Ethernet (HSE) network connections. • Access devices directly via an OPC server.
1788-CN2FF	• Connect via low-speed serial (H1) connections. • Bridge a ControlNet network to a Foundation Fieldbus. • Support redundant ControlNet media.

Foundation Fieldbus distributes and executes control in the device. The Foundation Fieldbus linking device does the following:

- Bridges from an EtherNet/IP network to an H1 connection
- Accepts either HSE or EtherNet/IP messages and converts them to the H1 protocol

Figure 15 - Foundation Fieldbus Example



For more information about using the Foundation Fieldbus devices available from Rockwell Automation, see these publications:

- Foundation Fieldbus Linking Device User Manual, publication 1757-UM010
- ControlNet Foundation Fieldbus Linking Device User Manual, publication 1757-UM011
- RSFieldbus User Manual, publication RSBUS-UM001

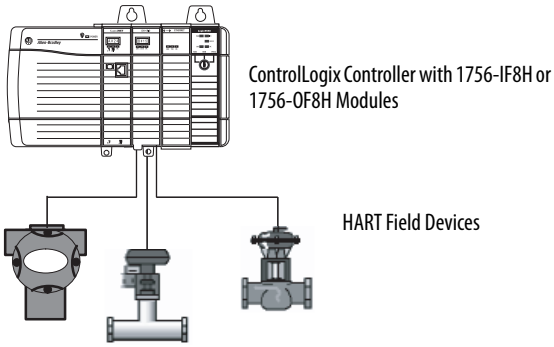
HART Communication

HART (Highway Addressable Remote Transducer) is an open protocol designed for process control instrumentation.

Device	Is used to
1756 analog I/O modules: • 1756-IF8H • 1756-OF8H	• Act as HART master to allow communication with HART field devices. • Interface directly with field devices (through built-in HART modems), eliminating need for external hardware and additional wiring. • Provide access to more field device data, including voltage and current measurements. • Directly connect asset management software to HART devices. • Support differential wiring for environments where improved noise immunity is needed (input modules).
ProSoft interface MVI56-HART	• Acquire data or control application with slow update requirements, such as a tank farm. • Does not require external hardware to access HART signal. • Does not provide a direct connection to asset management software.

The HART protocol combines digital signals with analog signals to ready the digital signal for the Process Variable (PV). The HART protocol also provides diagnostic data from the transmitter.

Figure 16 - HART Protocol Example



For more information about using the HART I/O modules, see the ControlLogix HART Analog I/O Modules User Manual, publication 1756-UM533.

For more information about the ProSoft HART interface, see the ProSoft Technologies website at http://www.prosoft-technology.com.

Notes:

Serial Communication on 1756-L6*x* Controllers

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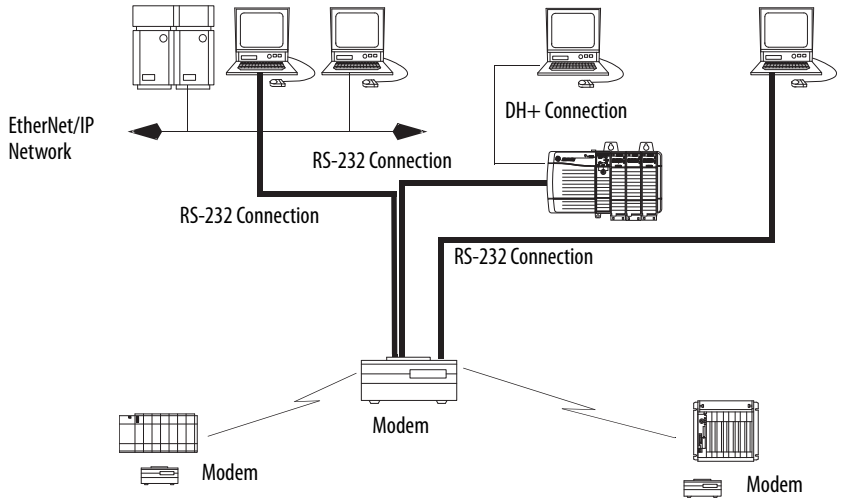
1756-L6*x* Controller Serial Port

The 1756-L6*x* ControlLogix controllers have a built-in RS-232 port that can be used in a variety of serial-based applications. The potential serial communication applications include the following:

- DF1 modes (including broadcast message support)
- DF1 radio modem
- ASCII device communication

Figure 17 - ControlLogix DF1 Device Communication Example



ControlLogix Chassis Serial Communication Options

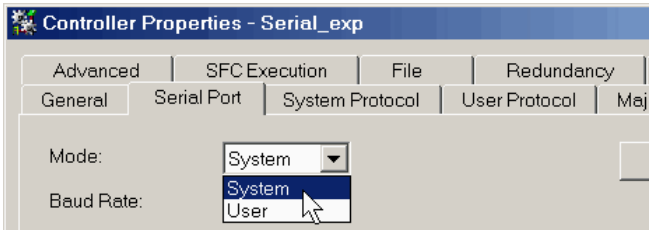
You can use the serial port of the ControlLogix controller and/or use ProSoft modules in the ControlLogix to achieve serial communication. Options specific to the ControlLogix controller serial port are described in this chapter.

For more information about ProSoft modules that can be used to establish serial communication, see the ProSoft Technology website or go to http://www.prosoft-technology.com and browse available products.

Communication with Serial Devices

When configuring the controller for serial communication, you first specify a Serial Port mode (System or User), then a protocol.

Figure 18 - Serial Port Mode in the Controller Properties



This table describes the serial communication protocols for use with each mode.

Table 23 - Serial Port Modes, Protocols, and Uses

Mode	Protocol	Is used to	See page
System	DF1 Master	Control polling and message transmission between the master and slave nodes.	101
	DF1 Point to Point	• Communicate between the controller and one other DF1-protocol-compatible device. • Program the controller via the serial port.	101
	DF1 Radio Modem	• Communication with SLC 500 and MicroLogix™ 1500 controllers. • This protocol supports master/slave and store/forward configurations.	102
	DF1 Slave	Setup the controller as a slave station in a master/slave serial communication network.	104
	DH-485	Communication with other DH-485 devices via a multi-master and token-passing network that enables programming and peer-to-peer messaging.	105
User	ASCII	• Communicate with ASCII devices. • Use ASCII instructions to read and write data from and to an ASCII device.	107

DF1 Master Protocol

The master/slave network includes one controller configured as the master node and up to 254 slave nodes. Link slave nodes by using modems or line drivers.

A master/slave network can have node numbers from 0...254. Each node must have a unique node address. Also, at least two nodes, one master and one slave, must exist to define your link as a network.

DF1 Point to Point Protocol

The DF1 Point to Point protocol is used when connecting from the controller to one DF1 device. This is the default System mode protocol. Default parameters are listed in this table.

Table 24 - Default DF1 Point to Point Parameters

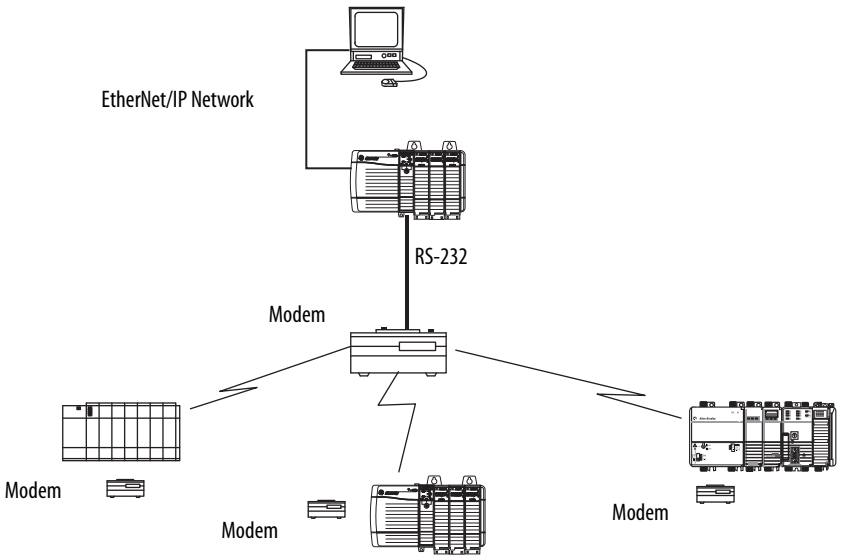
Parameter	Value
Baud Rate	19,200
Data Bits	8
Parity	None
Stop Bits	1
Control Line	No Handshake
RTS send Delay	0
RTS Off Delay	0

DF1 Radio Modem Protocol

Your ControlLogix controller includes a driver that allows it to communicate over the DF1 Radio Modem protocol. This driver implements a protocol, optimized for use with radio modem networks, that is a hybrid between DF1 full-duplex protocol and DF1 half-duplex protocol, and therefore is not compatible with either of these protocols.

IMPORTANT	The DF1 radio modem driver should be used only among devices that support and are configured for the DF1 Radio Modem protocol. Additionally, there are some radio modem network configurations that will not work with the DF1 radio modem driver. In these configurations, continue to use DF1 half-duplex protocol.

Figure 19 - DF1 Radio Modem Network Example



Like DF1 full-duplex protocol, the DF1 radio modem allows any node to initiate to any other node at any time (that is, if the radio modem network supports full-duplex data-port buffering and radio-transmission collision avoidance). Like DF1 half-duplex protocol, a node ignores any packets received that have a destination address other than its own, with the exception of broadcast packets and passthru packets.

Unlike either DF1 full-duplex or DF1 half-duplex protocols, the DF1 radio modem protocol does not include ACKs, NAKs, ENQs, or poll packets. Data integrity is ensured by the CRC checksum.

DF1 Radio Modem Advantages

The primary advantage of using the DF1 radio modem protocol for radio modem networks is in transmission efficiency. Each read/write transaction (command and reply) requires only one transmission by the initiator (to send the command) and one transmission by the responder (to return the reply). This minimizes the number of times the radios need to key-up to transmit, which maximizes radio life and minimizes radio power consumption.

In contrast, DF1 half-duplex protocol requires five transmissions for the DF1 master to complete a read/write transaction with a DF1 slave—three by the master and two by the slave.

The DF1 radio modem driver can be used in a pseudo master/slave mode with any radio modems, as long as the designated master node is the only node initiating MSG instructions, and as long as only one MSG instruction is triggered at a time.

For modern serial radio modems that support full-duplex data port buffering and radio transmission collision avoidance, the DF1 radio modem driver can be used to set up a masterless peer-to-peer radio network, where any node can initiate communication to any other node at any time, as long as all of the nodes are within radio range so that they receive each other's transmissions.

DF1 Radio Modem Limitations

These considerations must be made if you can implement the new DF1 radio modem driver in your radio modem network:

- If all of the devices on the network are ControlLogix controllers, you must configure them with the DF1 radio modem driver via RSLogix 5000 software, version 17.01.02 or later or Logix Designer application, version 21.00.00 or later. If not, then make sure that all of the nodes can support the DF1 radio modem protocol.

- If each node receives the radio transmissions of every other node, being both within radio transmission/reception range and on a common receiving frequency (either via a Simplex radio mode or via a single, common, full-duplex repeater) the radio modems must handle full-duplex data port buffering and radio transmission collision avoidance.

  If this is the case, you can take full advantage of the peer-to-peer message initiation capability in every node (for example, the ladder logic in any node can trigger a MSG instruction to any other node at any time).

  If not **all** modems can handle full-duplex data port buffering and radio transmission collision avoidance, you may still be able to use the DF1 radio modem driver, but only if you limit MSG instruction initiation to a single master node whose transmission can be received by every other node.

- If not **all** nodes receive the radio transmission of every other node, you may still be able to use the DF1 radio modem driver, but only if you limit MSG instruction initiation to the node connected to the master radio modem whose transmissions can be received by every other radio modem in the network.

- You can take advantage of the ControlLogix controller channel-to-channel passthru to remotely program the other nodes via RSLinx Classic and Logix Designer applications running on a personal computer connected to a local ControlLogix controller via DH-485, DH+, or Ethernet network.

DF1 Radio Modem Protocol Parameters

Use this table as a reference when setting the parameters for the use of the DF1 Radio Modem Protocol.

Table 25 - DF1 Radio Protocol Parameters

Parameter	Description
Station Address	Specifies the node address of the controller on the serial network. Select a number 1…254 decimal, inclusive. To optimize network performance, assign node addresses in sequential order. Initiators, such as personal computers, should be assigned the lowest address numbers to minimize the time required to initialize the network.
Error Detection	Click one of the radio buttons to specify the error detection scheme used for all messages. • BCC - the processor sends and accepts messages that end with a BCC byte. • CRC - the processor sends and accepts messages with a 2 byte CRC.
Enable Store and Forward	Check 'Enable Store and Forward' if you want to enable the store and forward functionality. When enabled, the destination address of any received message is compared to the Store and Forward tag table. If there is a match, the message is then forwarded (re-broadcasted) out the port. From the Store and Forward Tag pull-down menu, choose an integer (INT[16]) tag. Each bit represents a station address. If this controller reads a message destined for a station that has its bit set in this table, it forwards the message.

DF1 Slave Protocol

With the DF1 slave protocol, a controller uses DF1 half-duplex protocol. One node is designated as the master and it controls who has access to the link. All the other nodes are slave stations and must wait for permission from the master before transmitting.

Make these considerations when using the DF1 Slave protocol:

- If multiple slave stations are used on the network, link slave stations by using modems or line drivers to the master.
- If you are using a single slave station on the network, you do not need a modem to connect the slave station to the master.
- Control parameters can be configured without handshaking.
- 2...255 nodes can be connected to a single link.

DH-485 Protocol

The controller can send and receive messages to and from other controllers on a DH-485 network. The DH-485 connection supports remote programming and monitoring via the Logix Designer application. However, excessive traffic over a DH-485 connection can adversely affect overall controller performance and lead to timeouts and decreased performance of the configuration.

You can also use a 1756-DH485 module to connect the ControlLogix chassis to a DH-485 network with multiple controllers. For more information, see the ControlLogix DH-485 Communication Module User Manual, publication 1756-UM532.

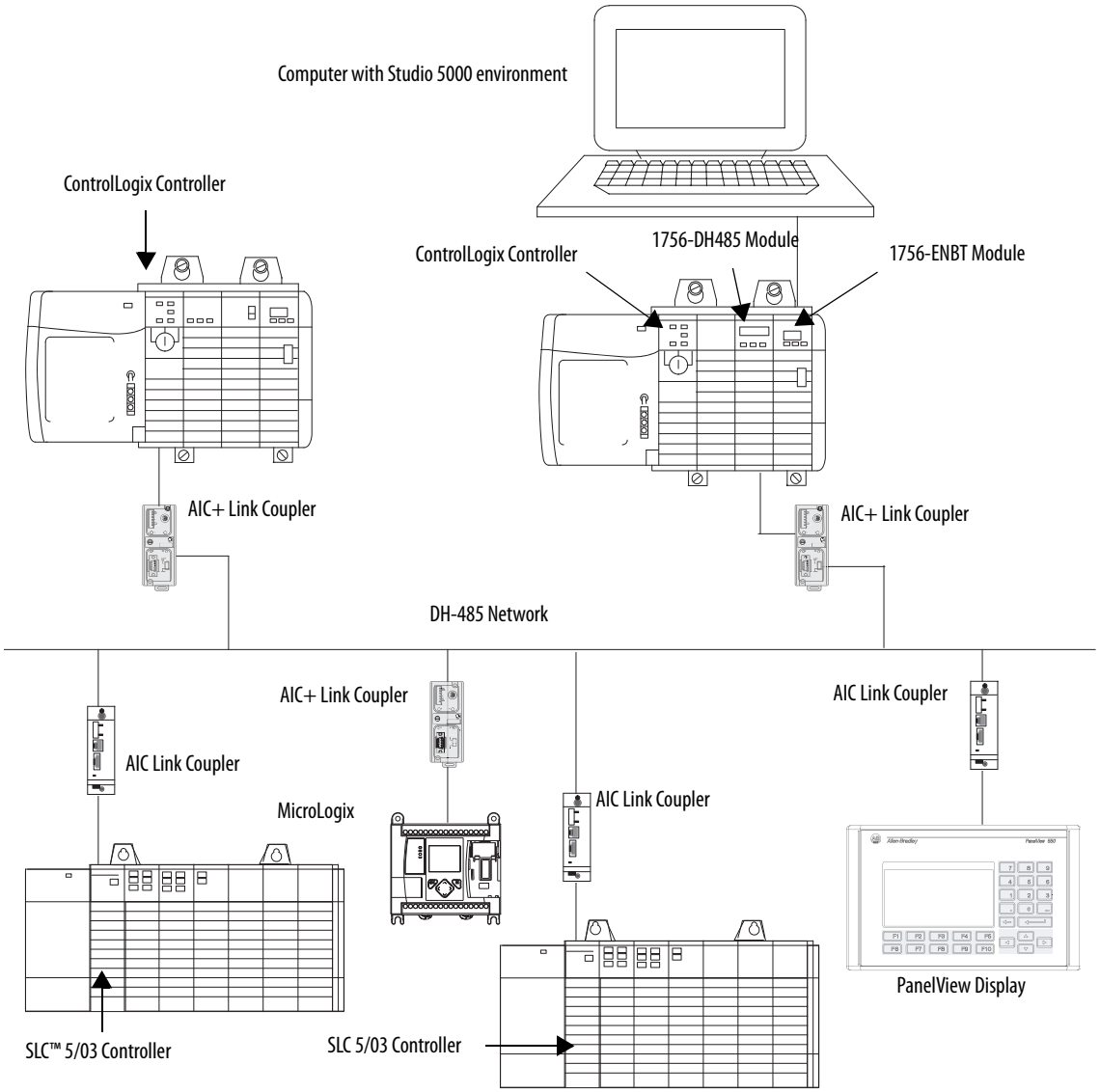
IMPORTANT	Use Logix5000 controllers on DH-485 networks only when you want to add controllers to an existing DH-485 network. For new applications with Logix5000 controllers, we recommend that you use networks in the NetLinx open architecture.

The DH-485 protocol uses RS-485 half-duplex as its physical interface. RS-485 is a definition of electrical characteristics, not a protocol. You can configure the RS-232 port of the ControlLogix controller to act as a DH-485 interface.

To connect the controller to the DH-485 network, you must use these components:

- A 1761-NET-AIC converter (two controllers can be connected to one converter)
- An RS-232 cable (catalog number 1756-CP3 or 1747-CP3) for each controller to connect to the converter

Figure 20 - DH-485 Network Communication Overview



IMPORTANT A DH-485 network consists of multiple cable segments. Limit the total length of all the segments to 1219 m (4000 ft).

ASCII Protocol

When you configure the serial port for User mode and the ASCII protocol, you can use it to do the following:

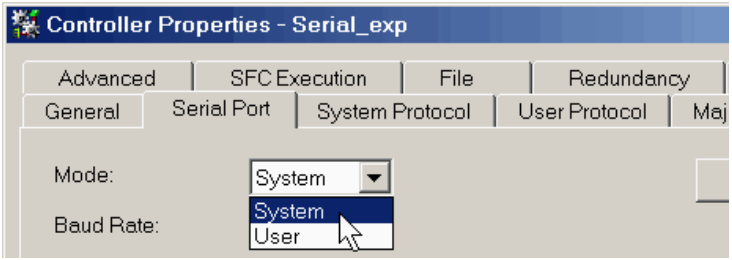
- Read ASCII characters from a weigh scale module or bar code reader.
- Send and receive messages from an ASCII-triggered device, such as a MessageView™ terminal.

After you configure the controller for use with the ASCII protocol, program the controller using the ASCII instructions. Reference the Logix5000 Controllers General Instruction Reference Manual, publication 1756-RM003, for information about the ASCII instructions.

Configure the 1756-L6*x* Controller for Serial Communication

Complete these steps to configure your 1756-L6*x* controller for serial communication after creating a controller project in the Logix Designer application.

1. Open the Controller Properties and click the Serial Port tab.

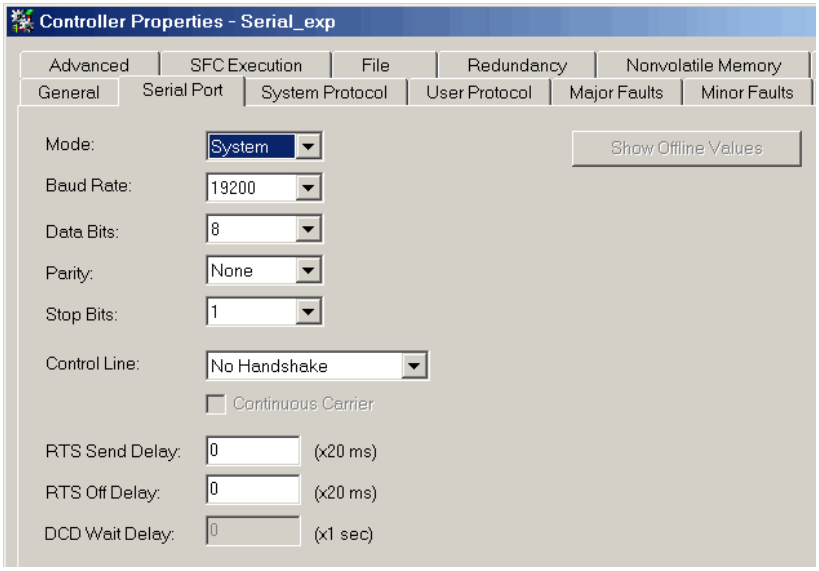


2. From the Mode pull-down menu, choose the mode that corresponds to your intended protocol.

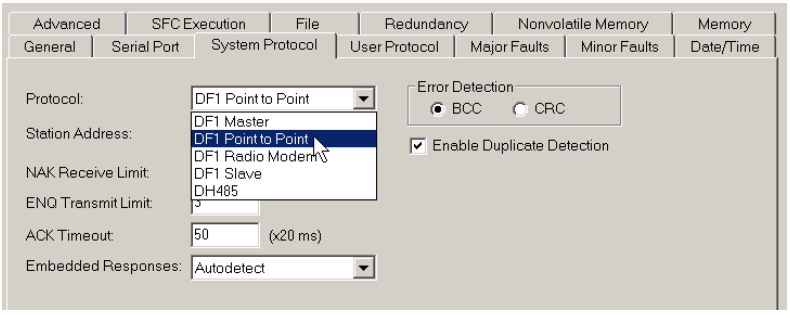
   Use this table as a reference.

For this protocol	Choose this mode
DF1 Master	System
DF1 Point to Point	
DF1 Radio Modem	
DF1 Slave	
DH-485	
ASCII	User

3. Specify the remaining properties in the Serial Port tab according to your communication preferences.

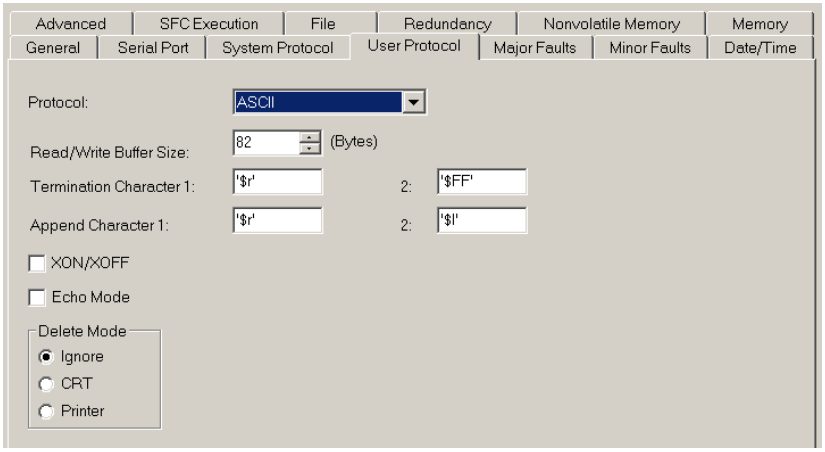


4. If you are using the System mode protocols, click the System Protocol tab and specify the protocol parameters.
   a. From the Protocol pull-down, choose the protocol you need.



   b. Specify the parameters for the protocol.

5. If you are using the User mode protocol (ASCII), click the User Protocol tab and specify the ASCII parameters.



After you have configured the controller for ASCII protocol communication, reference the Logix5000 Controllers General Instruction Reference Manual, publication 1756-RM003, for the available ASCII instructions.

Broadcast Messages over a Serial Port

You can broadcast messages over a serial port connection from a master controller to all of its slave controllers by using several communication protocols. These protocols include the following:

- DF1 Master
- DF1 Radio Modem
- DF1 Slave

Broadcasting over a serial port is achieved by using the 'message' tag. Because messages are sent to receiving controllers, only the 'write' type messages can be used for broadcasting.

The broadcast feature can be set up by using ladder logic or structured text. The broadcast feature can also be set by modifying the path value of a message tag in the tag editor.

To configure and program the controller to broadcast messages via the serial port, complete these procedures:

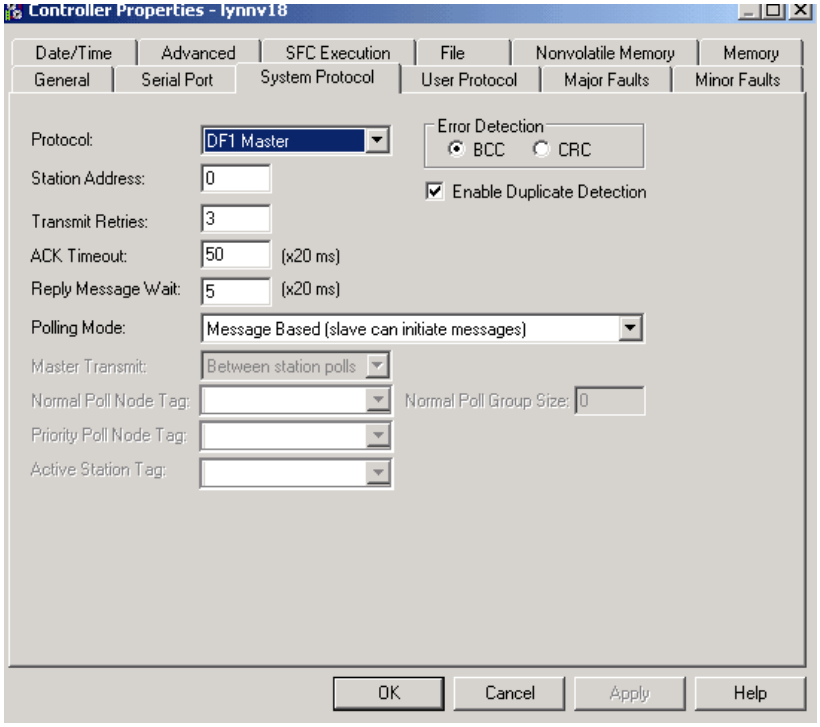
- Configure Controller Serial Port Properties on page 110
- Program the Message Instruction on page 111

For these procedure examples, ladder logic programming is used.

Configure Controller Serial Port Properties

First, set the System Protocol by following these steps.

1. In the Controller Organizer, right-click the controller and choose Properties.
2. On the Controller Properties dialog box, from the System Protocol tab, choose the settings for the controller, then click OK.



Use this table when specifying settings for the protocols listed.

Field	DF-1 Master Protocol	DF-1 Slave Protocol	DF-1 Radio Modem Protocol
Station Address	Controller station address number	Controller station address number	Controller station address number
Transmit Retries	3	3	N/A
ACK Timeout	50	N/A	N/A
Slave Poll Timeout	N/A	3000	N/A
Reply Message Wait	5	N/A	N/A
Polling Mode	Message: polls the slave by using the Message instruction Slave: initiates messages for slave-to-slave broadcast Standard: schedules polling for the slave	N/A	N/A
EOT Suppression	N/A	Disable	N/A
Error Detection	BCC	BCC	BCC
Duplicate Detection	Enabled	Enabled	N/A
Enable Store and Forward	N/A	N/A	Choose enable if you want to use the store and forward tag. The last bit of the INT[16] Enable Store and Forward array must be 'enabled.' For example, say you create an INT[16] tag named EnableSandF. Then EnableSandF[15].15 must be set to 1 for broadcast to work on radio modem.

Program the Message Instruction

Add and configure the Message instruction according to the protocol you are using. For more information about specifying the configuration details, see the Logix5000 Controllers General Instruction Reference Manual, publication 1756-RM003.

IMPORTANT When using structured text, broadcast over a serial port is set by typing MSG(aMsg) and right-clicking an MSG to display the Message Configuration dialog box.

Modbus Support

To use ControlLogix controllers with the Modbus protocol, establish a serial port connection and execute a specific ladder-logic routine.

Two controller projects specific to the Modbus network are available as sample programs within the Logix Designer application:

- ModbusMaster.ACD
- ModbusSlave.ACD

For information about using these sample programs, see the Using Logix5000 Controllers as Masters or Slaves on Modbus Application Solution, publication CIG-AP129.

Notes:

Manage Controller Communication

Topic	Page
Connection Overview	113
Produce and Consume (interlock) Data	114
Send and Receive Messages	116
Calculate Connection Use	117

Connection Overview

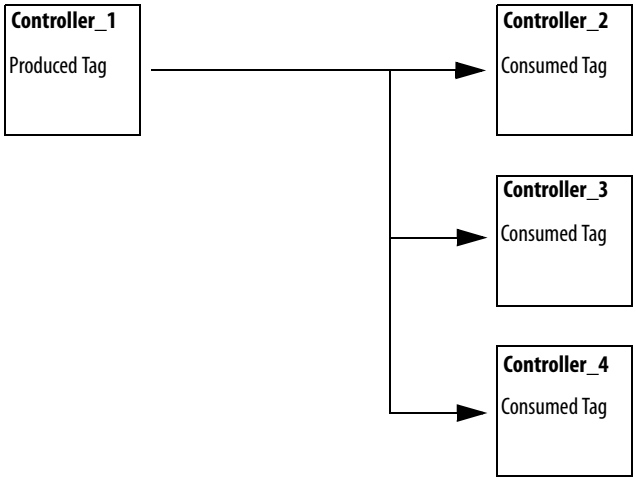
A Logix5000 system uses a connection to establish a communication link between two devices. The types of connections include the following:

- Controller-to-local I/O modules or local communication modules
- Controller-to-remote I/O or remote communication modules
- Controller-to-remote I/O (rack-optimized) modules
- Produced and consumed tags
- Messages
- Controller access via the Logix Designer application
- Controller access via RSLinx Classic or RSLinx Enterprise applications for HMI or other applications

Produce and Consume (interlock) Data

ControlLogix controllers let you produce (transmit) and consume (receive) system-shared tags.

Figure 21 - Illustration of Produced and Consumed Tags



The system-shared tags are explained in this table.

Table 26 - Produced and Consumed Tag Definitions

Tag	Definition
Produced tag	A tag that a controller makes available for use by other controllers. Multiple controllers can simultaneously consume (receive) the data. A produced tag sends its data to one or more consumed tags (consumers) without using logic.
Consumed tag	A tag that receives the data of a produced tag. The data type of the consumed tag must match the data type (including any array dimensions) of the produced tag. The RPI of the consumed tag determines the period at which the data updates.

For two controllers to share produced or consumed tags, both must be attached to the same network. You cannot bridge produced and consumed tags over two networks.

Produced and consumed tags use connections of both the controller and the communication modules being used. For a ControlNet network, produced and consumed tags use scheduled connections.

Connection Requirements of a Produced or Consumed Tag

Produced and consumed tags each require connections. As you increase the number of controllers that can consume a produced tag, you also reduce the number of connections the controller has available for other operations, like communication and I/O.

IMPORTANT If a consumed-tag connection fails, all of the other tags being consumed from that remote controller stop receiving new data.

Each produced or consumed tag uses the number of connections listed in this table. Adding status information to a produced/consumed tag does not impact the number of connections used.

Table 27 - Produced and Consumed Tag Connections

This Type of Tag	Uses This Many Connections	Of This Module
Produced tag	*number_of_configuredconsumers* + 1	Controller
Consumed tag	1	
Produced or consumed tag	1	Communication

EXAMPLE Calculations of connections for produced or consumed tags:

- A ControlLogix controller producing 4 tags for 1 controller uses 8 connections.

  Each tag uses 2 connections (1 consumer + 1 = 2).

  2 connections per tag x 4 tags = 8 connections.
- Consuming 4 tags from a controller uses 4 connections (1 connection per tag x 4 tags = 4 connections).

The number of available connections limits the number of tags that can be produced or consumed. If the controller uses all of its connections for I/O and communication devices, no connections are left for produced and consumed tags.

Table 28 - ControlLogix Modules and Available Connections

Module Type	Cat. No.	Available Connections
Controller	1756-L7*x*	500
	1756-L6*x*	250
EtherNet/IP	• 1756-EN2F • 1756-EN2T • 1756-EN2TXT • 1756-EN2TR	256
	• 1756-ENBT • 1756-EWEB	128
ControlNet	• 1756-CN2 • 1756-CN2R • 1756-CN2RXT	128
	• 1756-CNB • 1756-CNBR	64

For more information about produced/consumed tags, see the Logix5000 Controllers Produced and Consumed Tags Programming Manual, publication 1756-PM011.

Send and Receive Messages

Messages transfer data to other devices, such as other controllers or operator interfaces. The MSG instruction is a ladder logic output instruction that asynchronously reads or writes a block of data to or from another module over the backplane or a network. The size of the instruction depends on the data types and message command programmed by the user.

Messages use connection resources to send or receive data. Messages can leave the connection open (cache) or closed when the message is done transmitting.

Each message uses one connection out of the controller, regardless of how many devices are in the message path. To conserve connections, configure one message to read from or write to multiple devices.

Table 29 - Message Types

Message Type	Communication Method	Connected Message	Message Can Be Cached
CIP data table read or write	N/A	Configurable	Yes
PLC-2®, PLC-3®, PLC-5®, or SLC (all types)	CIP	No	No
	CIP with Source ID	No	No
	DH+	Yes	Yes
CIP generic	N/A	Optional (1)	Yes(2)
Block-transfer read or write	N/A	Yes	Yes

(1) You can connect CIP generic messages. However, for most applications we recommend you leave CIP generic messages unconnected.

(2) Consider caching only if the target module requires a connection.

For more information about using messages, see these publications:

- Logix5000 Controllers Messages, publication 1756-PM012
- Logix5000 Controllers General Instructions, publication 1756-RM003

Determine Whether to Cache Message Connections

When you configure a MSG instruction, you can choose whether to cache the connection. Use this table to determine if you should cache connections.

Table 30 - Options for Caching Connections

If the message executes	Then
Repeatedly	Cache the connection. This keeps the connection open and optimizes execution time. Opening a connection each time the message executes increases execution time.
Infrequently	Do not cache the connection. This closes the connection upon completion of the message, which frees up that connection for other uses.

TIP Cached connections transfer data faster than uncached connections.The controller only supports 32 cached messages.

Calculate Connection Use

The total connection requirements of a ControlLogix system include both local and remote connections.

Local Connections

Local connections refer to connections used to communicate between modules housed in the same ControlLogix chassis (that is, the local modules). Use this table to calculate the number of local connections based on the configuration of your local chassis.

Table 31 - Local Chassis Connections

Local Connection To	Device Quantity	Connections per Device	Total Connections
Local I/O module (always a direct connection)		1	
1756-M16SE, 1756-M08SE, or 1756-M02AE servo module		3	
• 1756-CN2, 1756-CN2R, 1756-CN2RXT ControlNet communication module • 1756-CNB, 1756-CNBR ControlNet communication module		0	
• 1756-EN2F, 1756-EN2T, 1756-EN2TXT, or 1756-EN2TR EtherNet/IP communication module • 1756-ENBT EtherNet/IP communication module		0	
1756-EWEB EtherNet/IP web server module		0	
1756-DNB DeviceNet communication module		2	
1756-RIO remote I/O communication module (Connection count depends on module configuration and could be as many as 10 per module.)		1	
1756-DHRIO DH+/universal remote I/O communication module Each adapter associated with the module		1 1	
1756-DH485 DH-485 communication module		1	
		Total	

Remote Connections

Use remote connections when the communication module is in a chassis that is remote from the controller. The number of connections a communication module supports determines how many remote connections the controller can access through that module.

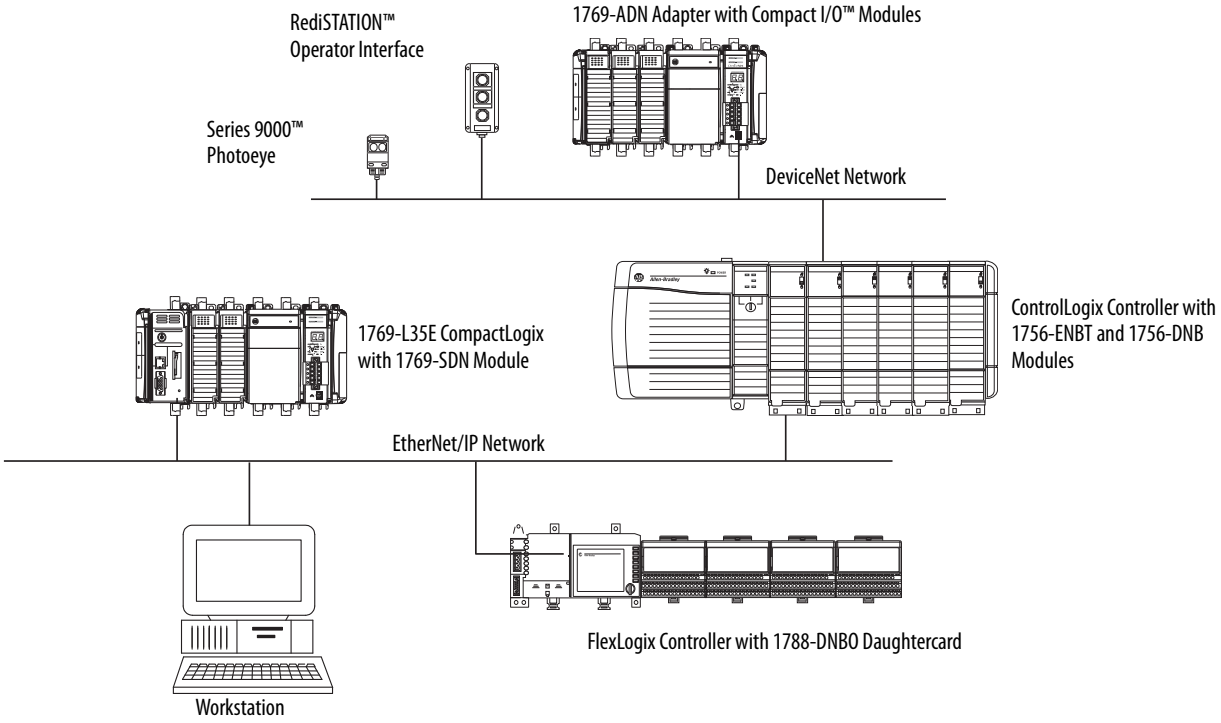
Table 32 - Remote Connections

Remote Connection Type	Device Quantity	Connections per Device	Total Connections
Remote ControlNet communication module I/O configured as direct connection (none) I/O configured as rack-optimized connection		 0 1	
Remote I/O module over a ControlNet network (direct connection)		1	
Remote EtherNet/IP communication module I/O configured as direct connection (none) I/O configured as rack-optimized connection		 0 1	
Remote I/O module over a EtherNet/IP network (direct connection)		1	
Remote device over a DeviceNet network (accounted for in rack-optimized connection for local 1756-DNB)		 0	
DeviceNet module in a remote chassis		2	
Other remote communication adapter		1	
Produced tag Each consumer		1 1	
Consumed tag		1	
Message (see Table 29 for message types) Connected Unconnected		 1 0	
Block-transfer message		1	
		Total	

Connections Example

In this example system, the 1756 ControlLogix controller does the following:

- Controls local digital I/O modules in the same chassis
- Controls remote I/O devices on a DeviceNet network
- Sends and receives messages to and from a CompactLogix controller on an EtherNet/IP network
- Produces one tag that the 1794 FlexLogix controller consumes
- Is programmed via the Logix Designer application



The ControlLogix controller in this example uses these connections.

Table 33 - Connections Example Calculation

Connection Type	Device Quantity	Connections per Device	Total Connections
Controller to local I/O modules	4	1	4
Controller to 1756-ENBT module	1	0	0
Controller to 1756-DNB module	1	2	2
Controller to Logix Designer application	1	1	1
Message to CompactLogix controller	2	1	2
Produced tag Consumed by FlexLogix controller	1 1	1 1	1 1
		Total	11

Notes:

I/O Modules

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Reconfigure an I/O Module	131
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Selecting ControlLogix I/O Modules

Rockwell Automation offers several ControlLogix I/O modules for use in ControlLogix systems. When you select your I/O modules, remember the following:

- A wide variety of digital, analog, and specialty I/O modules are available from Rockwell Automation. Some features of these I/O modules include the following:
  - Field-side diagnostics
  - Electronic fusing
  - Individually-isolated inputs/outputs
- Removable terminal blocks (RTBs) or 1492 wiring systems are required for use with I/O modules.
- 1492 PanelConnect™ modules and cables can be used to connect input modules to sensors.

For more information about ControlLogix I/O module features, specifications, and wiring options, see the ControlLogix Selection Guide, publication 1756-SG001.

Local I/O Modules

The ControlLogix chassis you choose affects how many local I/O modules you can use. Several ControlLogix chassis sizes are available to suit your configuration requirements. You can fill the slots of your chassis with any combination of controllers, communication modules, and I/O modules.

This table lists the available ControlLogix chassis and the number of slots available with each.

Table 34 - ControlLogix and ControlLogix- Chassis and Slots

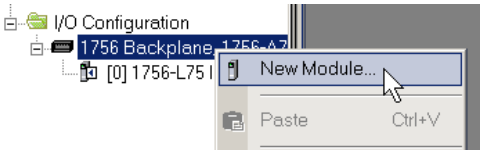
Chassis	Slots
1756-A4	4
1756-A4LXT	
1756-A5XT	5
1756-A7	7
1756-A7LXT	
1756-A7XT	
1756-A10	10
1756-A13	13
1756-A17	17

If you have empty slots in your chassis, use the 1756-N2 or 1756-N2XT slot-filler module.

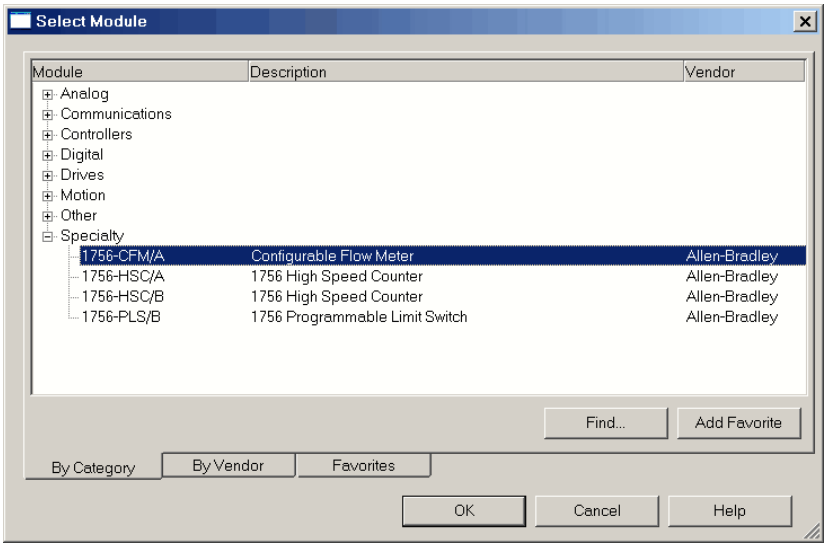
Add Local I/O to the I/O Configuration

If you are adding local I/O, add the I/O module to the backplane with the controller. To add an I/O module to the local chassis, complete these steps.

1. Right-click the backplane and choose New Module.



2. Select the I/O module you want to add and click OK.



3. Specify the configuration properties according to the module and network configuration you are using.

   For more information about the module configuration properties, see the user manual for the I/O module you are adding.

For this type of module	See this user manual
Analog I/O	ControlLogix Analog I/O Modules User Manual, publication 1756-UM009
Configurable flowmeter	ControlLogix Configurable Flowmeter Module User Manual, publication 1756-UM010
Digital I/O	ControlLogix Digital I/O Modules User Manual, publication 1756-UM058
HART analog I/O	ControlLogix HART Analog I/O Modules User Manual, publication 1756-UM533
High-speed analog I/O	ControlLogix High-speed Analog I/O Module User Manual, publication 1756-UM005
High-speed counter	ControlLogix High-speed Counter Module User Manual, publication 1756-UM007
Low-speed counter	ControlLogix Low-speed Counter Module User Manual, publication 1756-UM0536
Programmable limit switch	ControlLogix Programmable Limit Switch Module User Manual, publication 1756-UM002

Remote I/O Modules

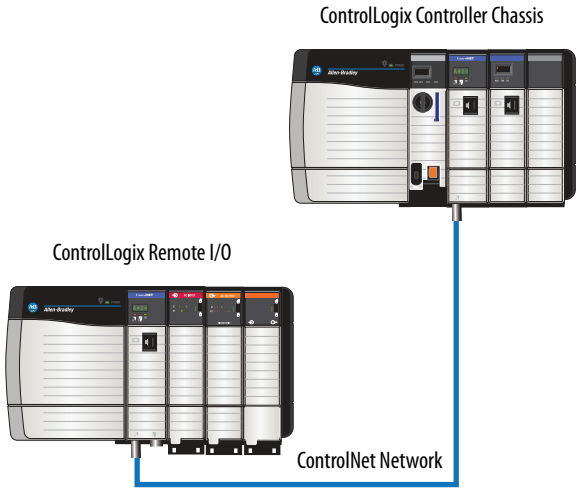
Remote I/O refers to I/O that is not located in the local chassis and is connected to the controller via a communication network.

The ControlLogix controller supports the use of remote I/O via these networks:

- EtherNet/IP
- ControlNet
- DeviceNet
- Universal remote I/O

For more information about the network configurations that can be used to connect remote I/O, see Communication Networks on page 83.

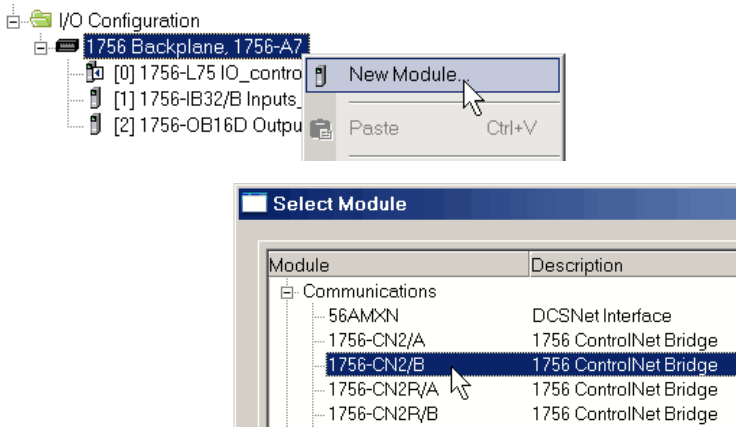
Figure 22 - ControlLogix Controller and Remote I/O Example



Add Remote I/O to the I/O Configuration

If you are adding remote I/O, add the I/O modules to the backplane of the remote communication module that is connected to the controller. To add a remote I/O to the I/O Configuration folder in the Logix Designer application, complete these steps.

1. Add a communication module to the backplane that contains the controller.

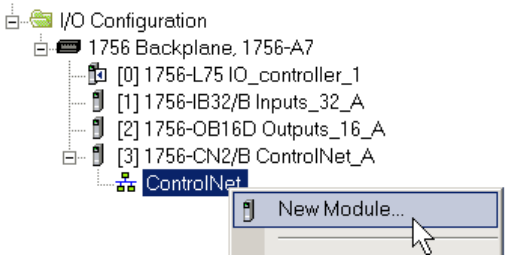


2. Specify the communication module properties according to your network configuration.

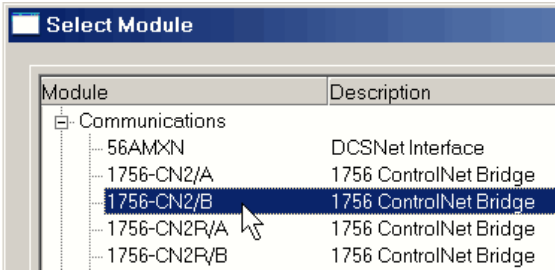
   For more information about the communication module and network properties, see the user manual for the network you are using:

   - ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001
   - DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004
   - EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001

3. Right-click the communication network and choose New Module.

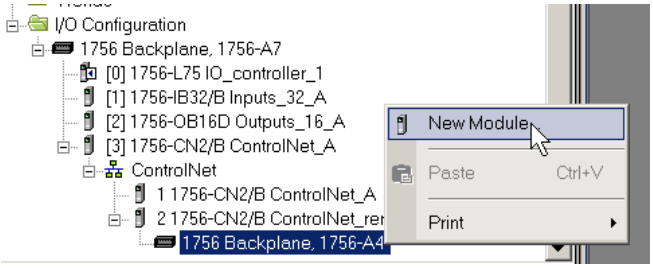


4. Add the remote communication module you are using.

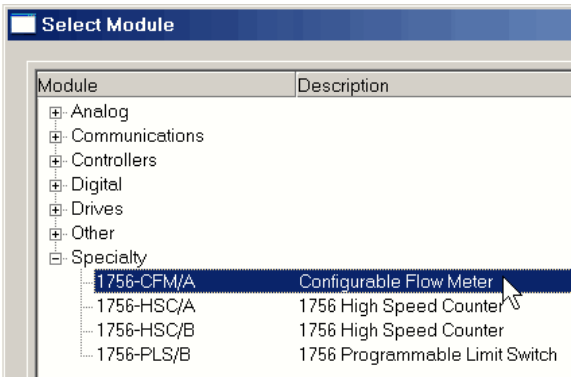


5. Specify the chassis and connection properties according to your network configuration.

6. Right-click the backplane of the newly-added communication module and choose New Module.



7. Select the I/O module you want to add and click OK.

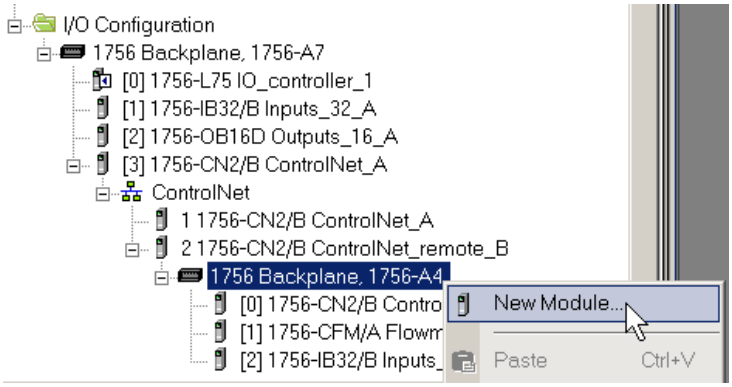


8. Specify the Module Properties according to your module and application.

   For more information about the module configuration properties, see the user manual for the I/O module you are adding.

For this type of module	See this user manual
Analog I/O	ControlLogix Analog I/O Modules User Manual, publication 1756-UM009
Configurable flowmeter	ControlLogix Configurable Flowmeter Module User Manual, publication 1756-UM010
Digital I/O	ControlLogix Digital I/O Modules User Manual, publication 1756-UM058
HART analog I/O	ControlLogix HART Analog I/O Modules User Manual, publication 1756-UM533
High speed analog I/O	ControlLogix High Speed Analog I/O Module User Manual, publication 1756-UM005
High speed counter	ControlLogix High Speed Counter Module User Manual, publication 1756-UM007
Low-speed counter	ControlLogix Low-speed Counter Module User Manual, publication 1756-UM0536
Programmable limit switch	ControlLogix Programmable Limit Switch Module User Manual, publication 1756-UM002

9. Add any other I/O modules you are using in the remote chassis.



10. Complete steps 1...9 until your remote I/O network and I/O modules are configured.

Distributed I/O

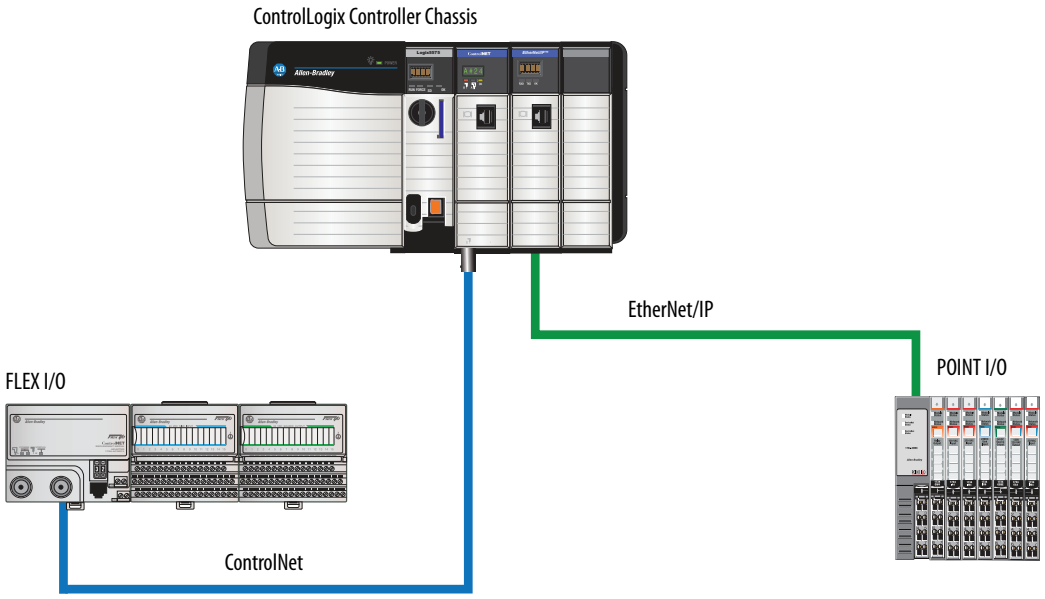
Distributed I/O refers to I/O that is located remote from the controller and is not designed for use with a specific controller. Examples of distributed I/O that can be used with Logix5000 controllers include the following:

- 1794 FLEX I/O modules
- 1734 POINT I/O modules
- 1797 FLEX Ex™ I/O modules
- 1738 ArmorPOINT® I/O modules
- 1732 ArmorBlock® I/O modules
- 1753 GuardPLC™ Safety I/O modules
- 1790 CompactBlock™ LDX I/O modules
- 1791 CompactBlock Guard Safety I/O modules
- 1791 CompactBlock I/O modules
- 1732DS ArmorBlock Guard Safety I/O modules
- 1792 ArmorBlock® MaXum™ I/O modules

Distributed I/O is connected to the ControlLogix controller via a communication network. The ControlLogix controller supports the use of distributed I/O via these networks:

- EtherNet/IP
- ControlNet
- DeviceNet

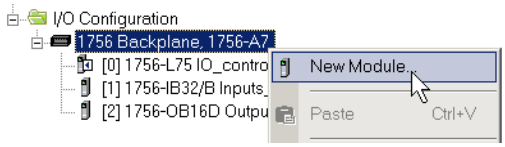
Figure 23 - ControlLogix System with Distributed I/O Example

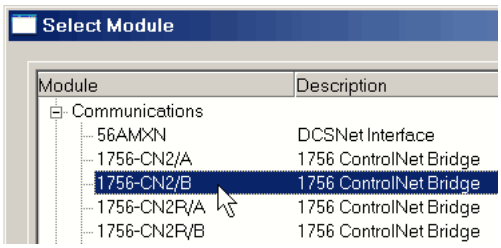


Add Distributed I/O to the I/O Configuration

If you are adding distributed I/O, add the I/O modules to the communication adapter of the I/O. To add distributed I/O to the I/O Configuration folder for the ControlLogix controller, complete these steps.

1. Add a communication module to the backplane that contains the controller.



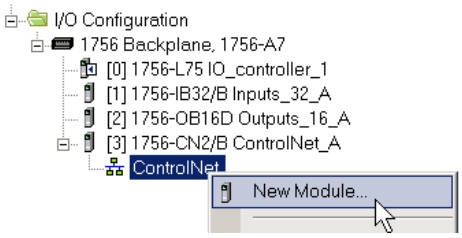


2. Specify the communication module properties according to your network configuration.

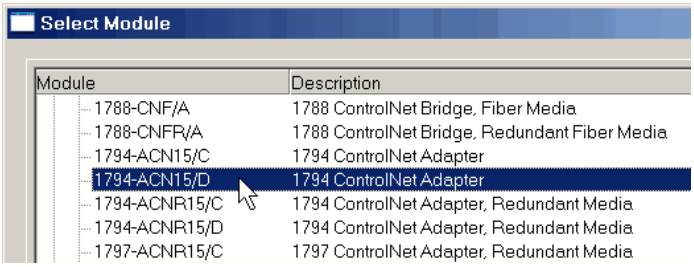
   For more information about the communication module and network properties, see the user manual for the network you are using:

   - ControlNet Modules in Logix5000 Control Systems User Manual, publication CNET-UM001
   - DeviceNet Modules in Logix5000 Control Systems User Manual, publication DNET-UM004
   - EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001

3. Right-click the communication network and choose New Module.

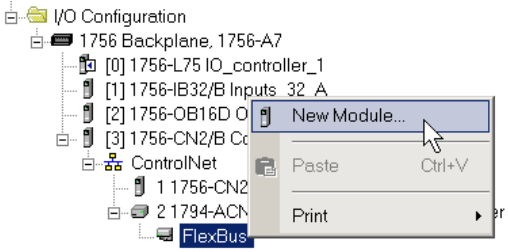


4. Add the communication adapter for the distributed I/O platform you are using.

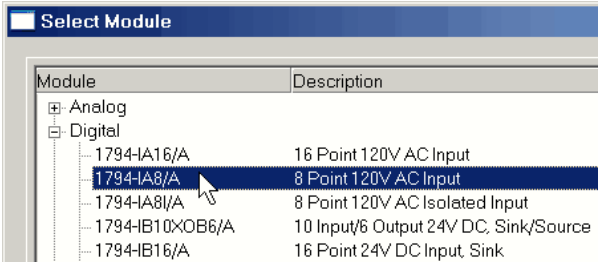


5. Specify the module and connection properties according to your network configuration.

6. Right-click the bus of the newly-added communication adapter and choose New Module.



7. Select the I/O module you want to add and click OK.



8. Specify the Module Properties according to your module and application.

   For more information about the module configuration properties, see the user manual for the I/O module you are adding.

9. Add any other I/O modules you are using in this bus.

10. Complete steps 1...9 until your remote I/O network and distributed I/O modules are configured.

Reconfigure an I/O Module

If an I/O module supports reconfiguration, you can reconfigure the module via the following:

- The Module Properties dialog box in the I/O Configuration folder
- A MSG instruction in program logic.

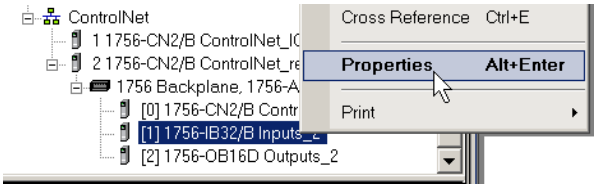
IMPORTANT Use care when changing the configuration of an I/O module. You could inadvertently cause the I/O module to operate incorrectly.

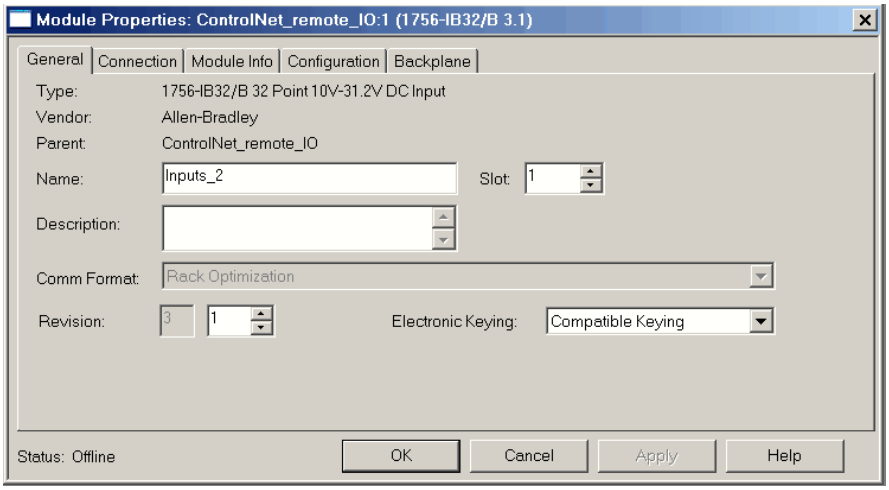
Use a MSG instruction of type Module Reconfigure to send new configuration information to an I/O module. During the reconfiguration, consider the following:

- Input modules continue to send input data to the controller
- Output modules continue to control their output devices

Reconfigure an I/O Module via the Module Properties

To reconfigure an I/O module using the module properties, right-click the module in the I/O Configuration tree and choose Properties. Then, edit the properties you need to change and click Apply.





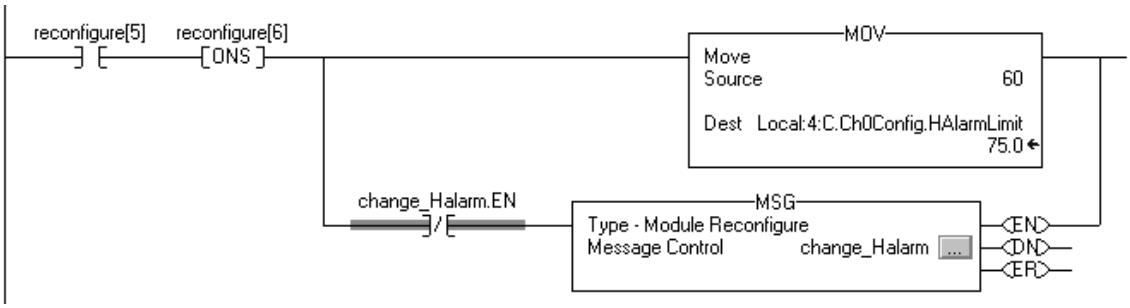
Reconfigure an I/O Module via a Message Instruction

To reconfigure an I/O module via a message instruction, use this procedure.

1. Set the required member of the configuration tag of the module to the new value.
2. Send a Module Reconfigure message to the module.

EXAMPLE **Reconfigure an I/O module**

When reconfigure[5] is on, the MOV instruction sets the high alarm to 60 for the local module in slot 4. The Module Reconfigure message then sends the new alarm value to the module. The ONS instruction prevents the rung from sending multiple messages to the module while the reconfigure[5] is on.



For more information about using Message instructions, see the Logix5000 Controllers General Instruction Reference Manual, publication 1756-RM003.

Add to the I/O Configuration While Online

With RSLogix 5000 software, version 15.02.00 or later, and Logix Designer application, version 21.00.00 or later, you can add I/O and other devices to the controller configuration while you are online and in Run mode.

The specific modules and devices you can add while online depends on the version of the software you are using. Later versions have more modules and devices that can be added while online.

You can add these modules and devices to the local or remote chassis via the unscheduled portion of a ControlNet network or via an EtherNet/IP network.

For more information about adding to the I/O Configuration while online, see the Runtime/On-line Addition of ControlLogix (1756) I/O over ControlNet and EtherNet/IP White Paper, publication LOGIX-WP006.

Modules and Devices that Can be Added While Online

These modules and devices **can be added** to the ControlLogix controller I/O configuration while online as of RSLogix 5000 software, version 19.01.00 or later and Logix Designer application, version 21.00.00 or later.

ControlLogix Modules that Can be Added While Online

- 1756 controllers
- 1756 ControlNet modules
- 1756 DeviceNet bridge modules
- 1756 EtherNet/IP modules
- 1756 I/O and speciality modules
- 1756-DHRIO

IMPORTANT These ControlLogix modules **cannot** be added while online:

- Motion modules (1756-M02AE, 1756-HYD02, 1756-M02AS, 1756-M03SE, 1756-M08SE, 1756-M08SEG, 1756-M16SE)
- 1756-RIO
- 1756-SYNCH
- 1756-ENBF
- 1756-56AMXN

PowerFlex Drives that Can be Added While Online

- PowerFlex® 4 Class Multi-E
- PowerFlex 400-E
- PowerFlex 400P-E
- PowerFlex® 40-E
- PowerFlex® 40P-E
- PowerFlex 4-E
- PowerFlex 4M-E
- PowerFlex 70® EC-C
- PowerFlex 70 EC-C
- PowerFlex 70 EC-E
- PowerFlex 70 EC-E
- PowerFlex 70 EC-Q
- PowerFlex 70 EC-Q
- PowerFlex 700 AC-C
- PowerFlex 700 AC-E
- PowerFlex 700 AC-Q
- PowerFlex 700 Vector-200V-C
- PowerFlex 700 Vector-200V-E
- PowerFlex 700 Vector-200V-Q
- PowerFlex 700 Vector-400V-C
- PowerFlex 700 Vector-400V-E
- PowerFlex 700 Vector-400V-Q
- PowerFlex 700 Vector-600V-C
- PowerFlex 700 Vector-600V-E
- PowerFlex 700 Vector-600V-Q
- PowerFlex 7000 2-C
- PowerFlex 7000 2-E
- PowerFlex 7000 2-Q
- PowerFlex 7000-C
- PowerFlex 7000-E
- PowerFlex® 7000-Q
- PowerFlex® 700-200V-C
- PowerFlex 700-200V-E
- PowerFlex 700-200V-Q
- PowerFlex 700-400V-C
- PowerFlex 700-400V-E
- PowerFlex 700-400V-Q
- PowerFlex 700-600V-C
- PowerFlex 700-600V-E
- PowerFlex 700-600V-Q
- PowerFlex 700AFE-C
- PowerFlex 700AFE-E
- PowerFlex 700AFE-Q
- PowerFlex® 700H-C
- PowerFlex 700H-E
- PowerFlex 700H-Q
- PowerFlex 700S 2-200V
- PowerFlex 700S 2-400V
- PowerFlex 700S 2-600V
- PowerFlex 700S 2P-200V-C
- PowerFlex 700S 2P-200V-E
- PowerFlex 700S 2P-200V-Q
- PowerFlex 700S 2P-400V-C
- PowerFlex 700S 2P-400V-E
- PowerFlex 700S 2P-400V-Q
- PowerFlex 700S 2P-600V-C
- PowerFlex 700S 2P-600V-E
- PowerFlex 700S 2P-600V-Q
- PowerFlex 700S-200V-C
- PowerFlex 700S-200V-E
- PowerFlex 700S-200V-Q
- PowerFlex 700S-400V-C
- PowerFlex 700S-400V-E
- PowerFlex 700S-400V-Q
- PowerFlex 700S-600V-C
- PowerFlex 700S-600V-E
- PowerFlex 700S-600V-Q
- PowerFlex 70-C
- PowerFlex 70-E
- PowerFlex 70-E
- PowerFlex 70-Q
- PowerFlex 70-Q
- PowerFlex® 753-CNETC
- PowerFlex 753-NET-C
- PowerFlex 753-NET-E
- PowerFlex 753-NET-Q
- PowerFlex® 755-CNETC
- PowerFlex 755-EENET
- PowerFlex 755-NET-C
- PowerFlex 755-NET-E
- PowerFlex 755-NET-Q
- PowerFlex DC-200V-C
- PowerFlex DC-200V-E
- PowerFlex DC-200V-Q
- PowerFlex DC-400V-C
- PowerFlex DC-400V-E
- PowerFlex DC-400V-Q
- PowerFlex DC-600V-C
- PowerFlex DC-600V-E
- PowerFlex DC-600V-Q

Other Devices that Can be Added While Online

- 1305-BA*XX*A drives
- 1336E-IMPACT™Drive-EN1 drive
- 1336F-PLUS™IIDrive-EN1drive
- 1336R-REGENBrake-EN1 brake
- 1336S-PLUSDriveLG-EN1 drive
- 1336S-PLUSDriveSM-EN1 drive
- 1336T-FORCE™DriveCNA-EN1 drive
- 1336T-FORCEDrivePLC-EN1 drive
- 1336T-FORCEDriveStd-EN1 drive
- 1397DigitalDCDrive-EN1 drive
- 150 SMC™ FLEX motor controller
- 150-SMC™DialogPlus-EN1 motor controller
- 1757-FFLDC ControlNet Foundation Fieldbus device
- 2364F RGU-EN1 bus supply
- 48MS-SN1PF1-M2 Multivision Sensor
- 5*X*RF RFID interface device

Online Additions - ControlNet Considerations

ControlNet considerations that must be made depend upon the ControlLogix ControlNet modules you are using.

1756-CNB and 1756-CNBR Modules

When you add I/O to the ControlNet network via the 1756-CNB or 1756-CNBR modules while online, these considerations must be made:

- Digital I/O modules can be added as rack-optimized connections if the parent module is already configured with rack-optimized connections.

  TIP While you can add a new digital I/O module to an existing rack-optimized connection, you cannot add rack-optimized connections while online.

- Digital I/O modules can also be added as direct connections.
- Analog I/O modules can be added only as direct connections.
- Disable the Change of State (COS) feature on digital input modules because it can cause inputs to be sent more quickly than the RPI.

- If you plan to add large amounts of I/O to the ControlNet network, dedicate one ControlNet network for I/O. For the dedicated ControlNet network, verify that there is little or none of the following:
  - HMI traffic
  - MSG traffic
  - Programming workstations
- Requested Packet Intervals (RPIs) faster than 25 ms for unscheduled modules can overload the 1756-CNB or 1756-CNBR communication module. To avoid the overload, make these considerations:
  - Use a NUT of 10 ms or more.
  - Keep the SMAX and UMAX values as small as possible.
- If the module has a Real Time Sample (RTS), it should be disabled or set to a rate that is greater than the RPI.
- You can add I/O modules until you reach these limits:
  - 75% of CPU utilization of the 1756-CNB or 1756-CNBR communication module.
  - Plan for a CPU-use increase of 1...4% of the 1756-CNB or 1756-CNBR module for each I/O module you add, depending on the RPI.
  - 48 connections on the 1756-CNB or 1756-CNBR communication module.
  - Less than 400,000 unscheduled bytes per second are displayed in RSNetWorx for ControlNet software after the network has been scheduled.

1756-CN2, 1756-CN2R, 1756-CN2RXT Modules

The use of 1756-CN2/B, 1756-CN2R/B, and 1756-CN2RXT modules provides increased capacity for adding I/O while online compared to 1756-CNB or 1756-CNBR modules. With this increased capacity, you can easily add I/O and increase ControlNet connections used with significantly less impact on the overall system.

This table demonstrates the performance factors of the 1756-CN2/B, 1756-CN2R/B, and 1756-CN2RXT modules when adding I/O online.

Table 35 - 1756-CN2, 1756-CN2R, and 1756-CN2RXT Performance Example(1)

No. of Direct Analog I/O Connections Added Online	RPI = 2 ms		RPI = 4 ms		RPI = 10 ms		RPI = 20 ms		RPI = 50 ms		RPI = 100 ms	
	CPU %(2)	Avg. API(3)	CPU %(2)	Avg. API(3)	CPU %(2)	Avg. API(3)	CPU %(2)	Avg. API(3)	CPU %(2)	Avg. API(3)	CPU %(2)	Avg. API(3)
0	1.50%	N/A	1.50%	N/A	1.50%	N/A	1.50%	N/A	1.50%	N/A	1.50%	N/A
1	4.80%	2.0	3.70%	4.0	2.50%	10.0	2.30%	20.0	1.90%	50.0	1.70%	100.0
2	7.00%	2.0	5.00%	4.0	3.30%	10.0	2.70%	20.0	2.10%	50.0	1.90%	100.0
3	9.00%	2.0	6.10%	4.0	3.80%	10.0	3.00%	20.0	2.20%	50.0	2.00%	100.0
4	11.20%	2.2	7.40%	4.0	4.40%	10.0	3.40%	20.0	2.40%	50.0	2.10%	100.0
5	11.50%	3.3	8.70%	4.0	5.00%	10.0	3.70%	20.0	2.60%	50.0	2.20%	100.0
6	12.80%	3.3	9.70%	4.0	5.50%	10.0	4.00%	20.0	2.70%	50.0	2.30%	100.0
7	13.80%	3.4	10.80%	4.0	5.90%	10.0	4.30%	20.0	2.90%	50.0	2.30%	100.0
8	15.10%	3.4	11.90%	4.0	6.40%	10.0	4.50%	20.0	3.00%	50.0	2.50%	100.0
9	15.00%	3.3	13.20%	4.0	7.00%	10.0	4.80%	20.0	3.20%	50.0	2.60%	100.0
10	15.60%	3.6	13.20%	4.0	7.50%	10.0	5.20%	20.0	3.40%	50.0	2.70%	100.0
11	16.40%	3.8	13.50%	4.0	8.20%	10.0	5.50%	20.0	3.50%	50.0	2.70%	100.0
12	17.00%	3.8	14.00%	4.0	8.80%	10.0	5.80%	20.0	3.70%	50.0	2.80%	100.0
13	17.80%	3.7	14.60%	4.0	9.30%	10.0	6.10%	20.0	3.80%	50.0	2.90%	100.0
14	18.50%	3.7	15.20%	4.0	9.90%	10.0	6.40%	20.0	4.00%	50.0	2.90%	100.0
15	19.40%	3.9	15.80%	4.0	10.50%	10.0	6.70%	20.0	4.10%	50.0	3.00%	100.0

(1) Example assumes that adequate unscheduled bandwidth is available.
(2) Approximate use of the module's central-processing unit (CPU) in percent.
(3) The average Actual Packet Interval with 2000 samples (shown in ms).

Because of the increased performance provided by the 1756-CN2, 1756-CN2R, and 1756-CN2RXT modules, many of the considerations that must be made with the 1756-CNB and 1756-CNBR modules are not applicable. With the 1756-CN2, 1756-CN2R, and 1756-CN2RXT modules, you can add I/O while online as long as you use reasonable RPI settings and remain within the CPU limitations of the ControlNet module.

When adding to the I/O Configuration with 1756-CN2, 1756-CN2R, and 1756-CN2RXT modules, make these considerations:

- Digital I/O modules can be added as rack-optimized connections if the parent module is already configured with rack-optimized connections.

  TIP While you can add a new digital I/O module to an existing rack-optimized connection, you cannot add rack-optimized connections while online.

- Digital I/O modules can also be added as direct connections.
- Analog I/O modules can be added only as direct connections.

- Disable the Change of State (COS) feature on digital input modules because it can cause inputs to be sent more quickly than the RPI.
- If you plan to add large amounts of I/O to the ControlNet network, dedicate one ControlNet network for I/O. For the dedicated ControlNet network, verify that there is little or none of the following:
  - HMI traffic
  - MSG traffic
  - Programming workstations
- If the module has a Real Time Sample (RTS), it should be disabled or set to a rate that is greater than the RPI.
- You can add I/O modules until you reach these limits:
  - 80% of CPU utilization of the 1756-CN2, 1756-CN2R, or 1756-CN2RXT communication module.
  - Less than 400,000 unscheduled bytes per second are displayed in RSNetWorx for ControlNet software after the network has been scheduled.

Online Additions—EtherNet/IP Considerations

When you add I/O modules to the EtherNet/IP network, make these considerations:

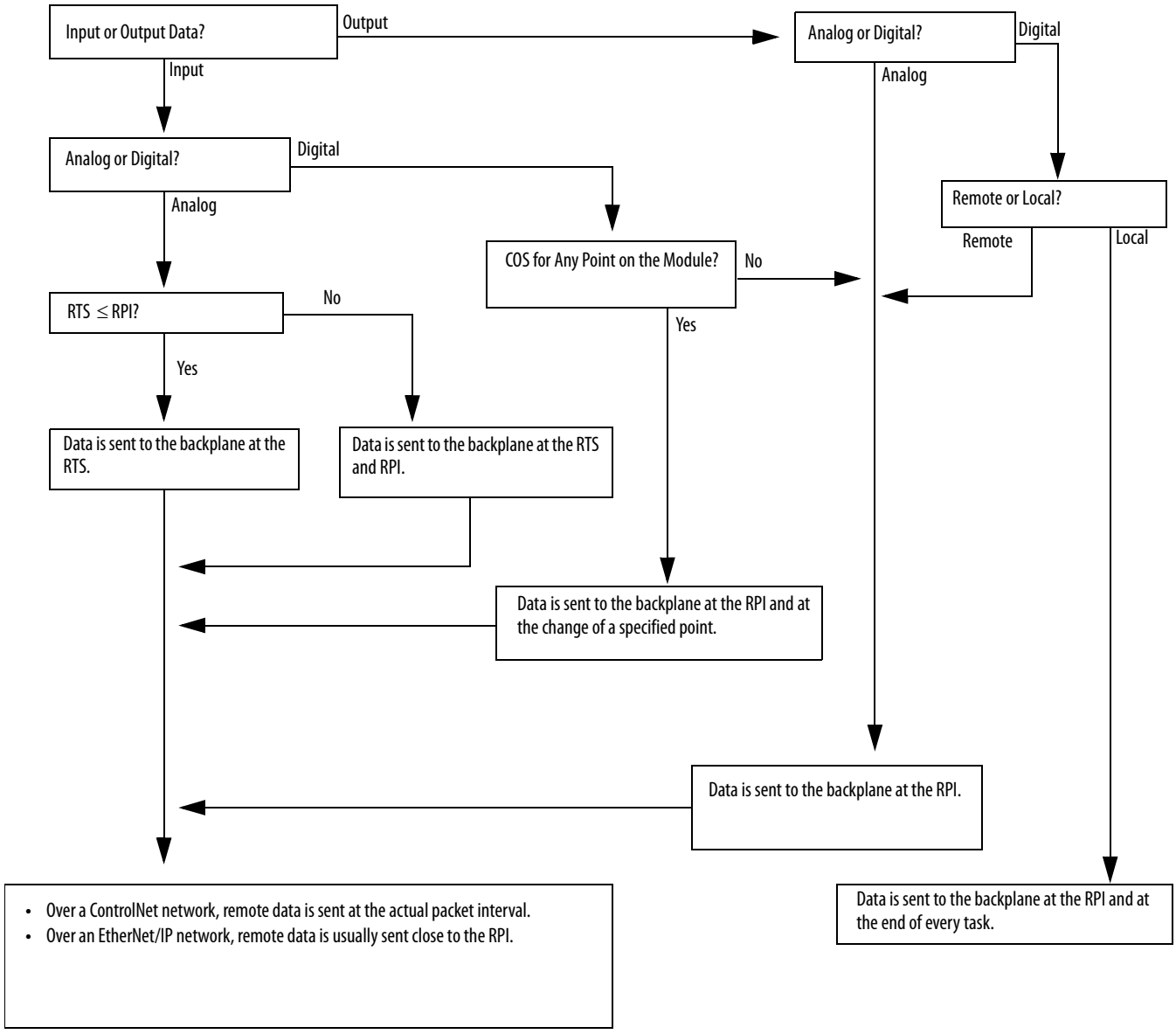
- The EtherNet/IP I/O modules you add can be added as these connection types:
  - Rack-optimized connections, including new and existing connections
  - Direct connections
- You can add I/O modules until you reach the limits of the communication module's connections.

  For EtherNet/IP module limitations, see the EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

Determine When Data Is Updated

ControlLogix controllers update date asynchronously with the execution of logic. Use this flowchart to determine when a producer, such as a controller, input module, or bridge module, will send data.

Figure 24 - Data Update Flowchart


Input or Output Data?
Output
Input
Analog or Digital?
Digital
Analog
Analog or Digital?
Digital
Remote or Local?
Remote
Local
Analog
COS for Any Point on the Module?
No
Yes
RTS ≤ RPI?
No
Yes
Data is sent to the backplane at the RTS.
Data is sent to the backplane at the RTS and RPI.
Data is sent to the backplane at the RPI and at the change of a specified point.
Data is sent to the backplane at the RPI.
Data is sent to the backplane at the RPI and at the end of every task.
• Over a ControlNet network, remote data is sent at the actual packet interval.
• Over an EtherNet/IP network, remote data is usually sent close to the RPI.

Notes:

Develop Motion Applications

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Motion Control Options

ControlLogix controllers support digital, analog, and Integrated Motion interfaces:

- Digital drive interfaces include EtherNet/IP connected drives and SERCOS interface connected drives.
- Analog drives support ±10V analog output and can interface with a variety of feedback device types including quadrature encoder, SSI, and LVDT feedback.
- Integrated Motion supports Kinetix 350, Kinetix 5500, Kinetix 6500, and PowerFlex 755 drives.

Motion Overview

The configuration process varies, depending on your application and your drive selection. The following are general steps to configure a motion application.

1. Create a controller project.
2. Select the type of drive.

Drive Type	Requirements
CIP Sync	• EtherNet/IP communication module • Digital drive with an EtherNet/IP connection
SERCOS interface	Select a SERCOS interface module: • 1756-M03SE • 1756-M08SE • 1756-M16SE
Analog interface	Select an analog interface module: • 1756-HYD02 • 1756-M02AE • 1756-M02AS

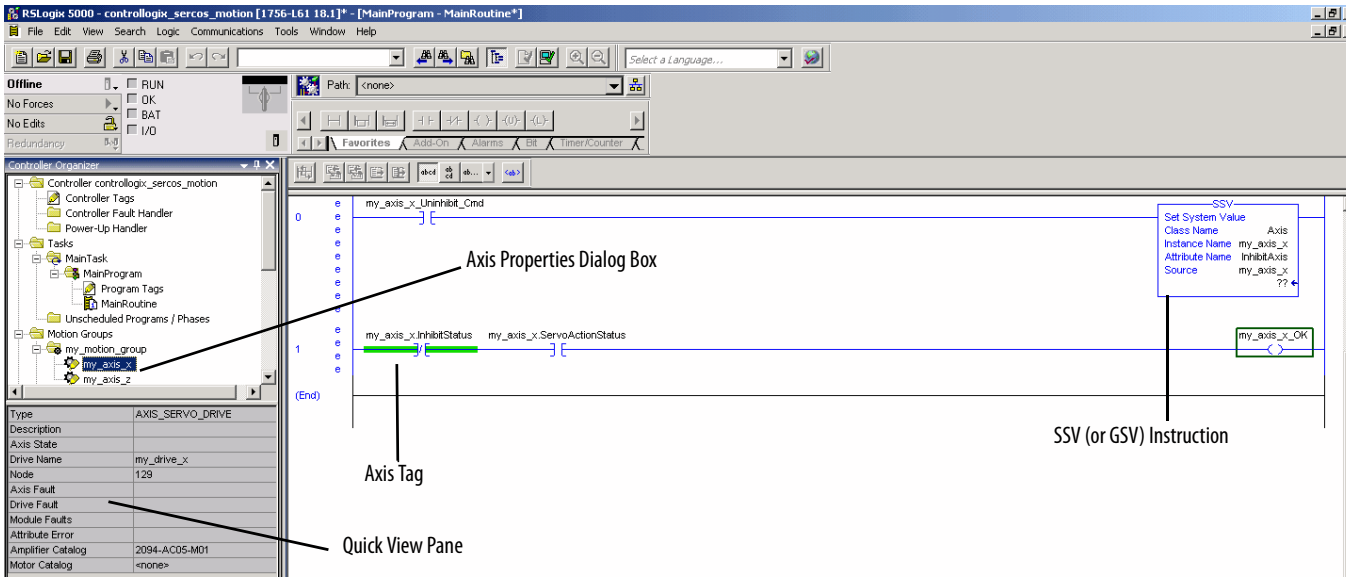
3. Create axis tags as needed.
4. Configure the drive.
5. Create axes as needed.

Obtain Axis Information

You can obtain axis information by using these methods:

- Double-click the axis to open the Axis Properties dialog box.
- Use a Get System Value (GSV) or Set System Value (SSV) instruction to read or change the configuration at run-time.
- View the Quick View pane to see the state and faults of an axis.
- Use an axis tag for status and faults.

Figure 25 - Obtain Axis Information

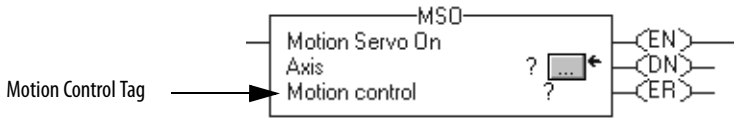


Program Motion Control

The controller provides a set of motion control instructions for your axes:

- The controller uses these instructions just like the rest of the Logix5000 instructions.
- Each motion instruction works on one or more axes.
- Each motion instruction needs a motion control tag. The tag uses a MOTION_INSTRUCTION data type and stores the instruction's information status.
- You can program using motion control instructions in these programming languages:
  - Ladder Diagram (LD)
  - Structured Text (ST)
  - Sequential Function Chart (SFC)

Figure 26 - Motion Control Instruction

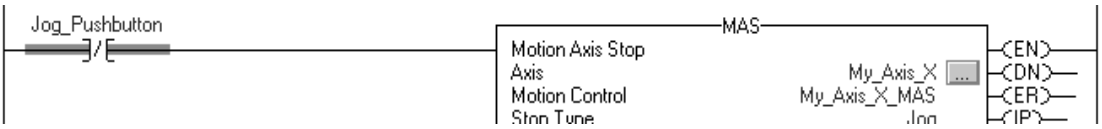


ATTENTION: Use the tag for the motion control operand of motion instruction only once. Unintended operation of the control variables may happen if you reuse of the same motion control tag in other instructions.

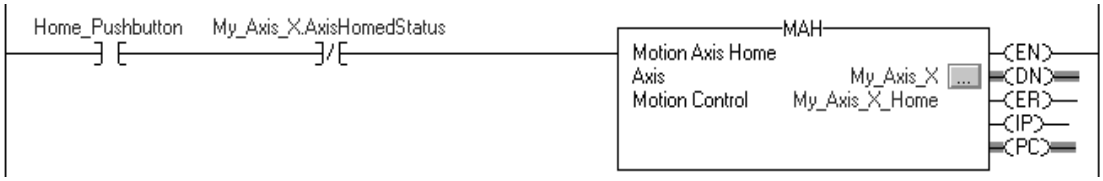
Example

In this example, a simple ladder diagram that homes, jogs, and moves an axis.

If Initialize_Pushbutton = on and the axis = off (My_Axis_X.ServoActionStatus = off) then the MSO instruction turns on the axis.

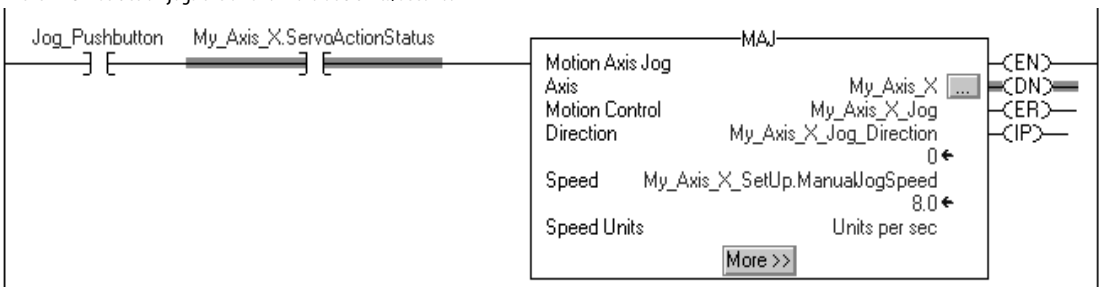


If Home_Pushbutton = on and the axis hasn't been homed (My_Axis_X.AxisHomedStatus = off) then the MAH instruction homes the axis.



If Jog_Pushbutton = on and the axis = on (My_Axis_X.ServoActionStatus = on) then

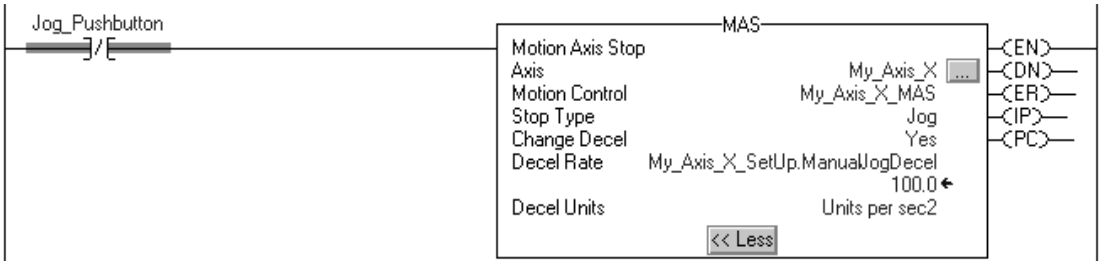
the MAJ instruction jogs the axis forward at 8 units/second.



If Jog_Pushbutton = off then

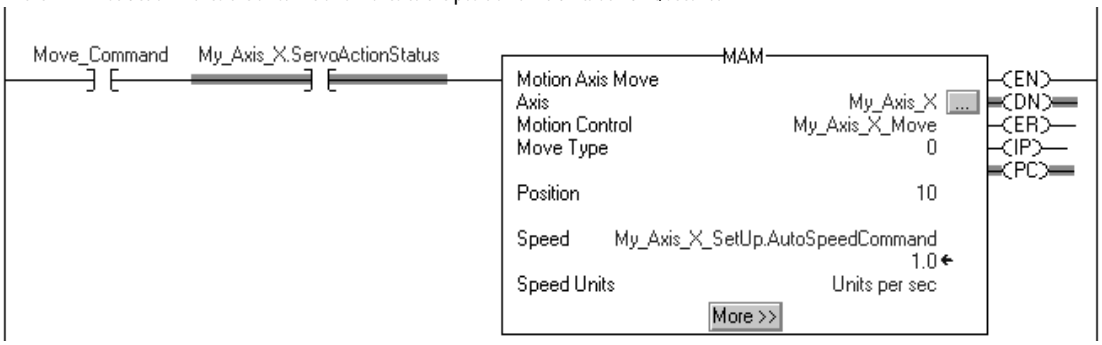
the MAS instruction stops the axis at 100 units/.second^2.

Make sure that Change Decel is Yes. Otherwise, the axis decelerates at its maximum speed.



If Move_Command = on and the axis = on (My_Axis_X.ServoActionStatus = on) then

the MAM instruction moves the axis. The axis moves to the position of 10 units at 1 unit/second.



Additional Resources

Refer to these publications for additional information about motion control.

Resource	Description
SERCOS Motion Configuration and Startup User Manual, publication MOTION-UM001	Details how to configure a SERCOS motion application system.
Motion Coordinated Systems User Manual, publication MOTION-UM002	Details how to create and configure a coordinated motion application system.
CIP Motion Configuration and Startup User Manual, publication MOTION-UM003	Details how to configure a CIP motion application system.
Logix5000 Controllers Motion Instructions Reference Manual, publication MOTION-RM002	Provides programmers with details about the motion instructions that are available for a Logix5000 controller.

Develop Applications

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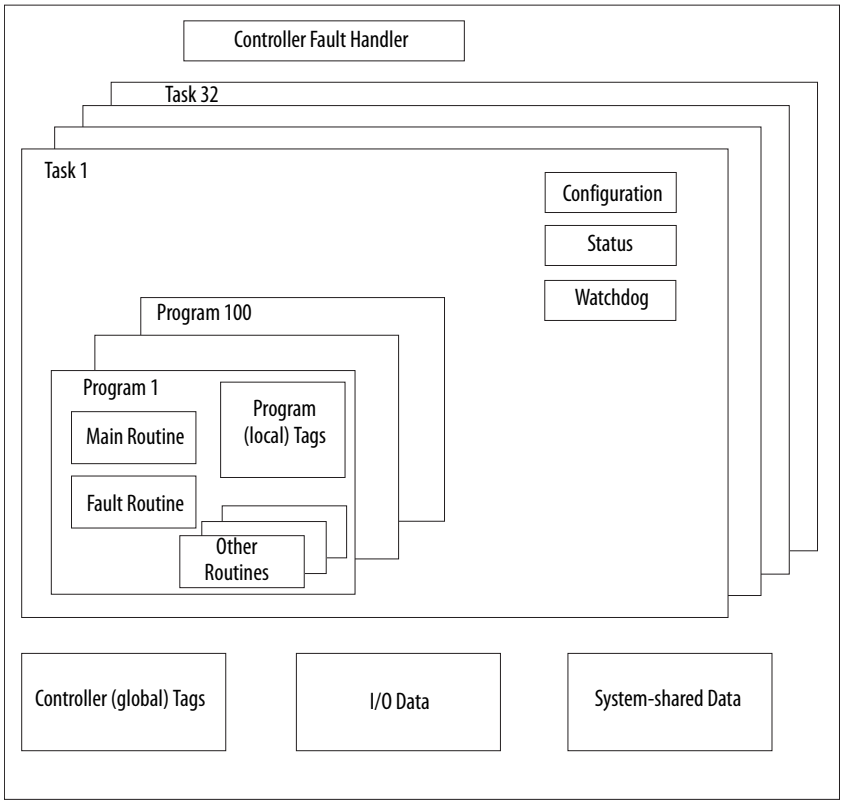
Elements of a Control Application

A control application is comprised of several elements that require planning for efficient application execution. Application elements include the following:

- Tasks
- Programs
- Routines
- Tags

Figure 27 - Elements of a Control Program



Tasks

A Logix5000 controller lets you use multiple tasks to schedule and prioritize the execution of your programs based on specific criteria. This multitasking allocates the controller's processing time among the different operations in your application:

- The controller executes only one task at a time.
- One task can interrupt another's execution and take control.
- In any given task, multiple programs may be used. However, only one program executes at a time.

Figure 28 - Task within a Control Application

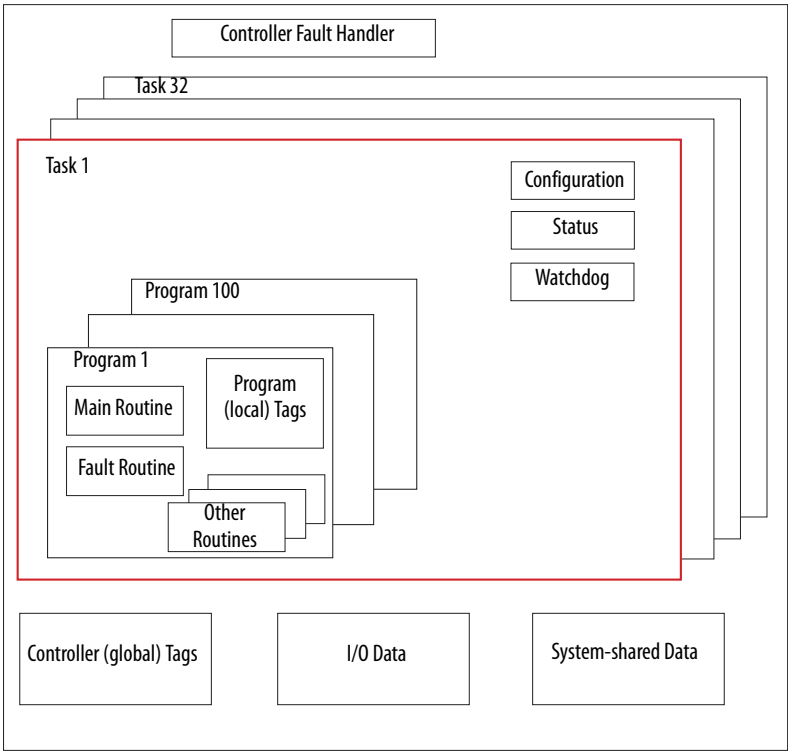
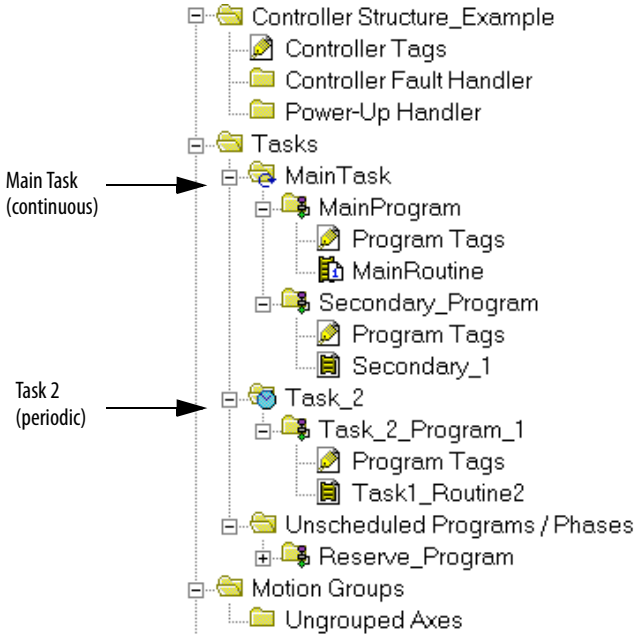
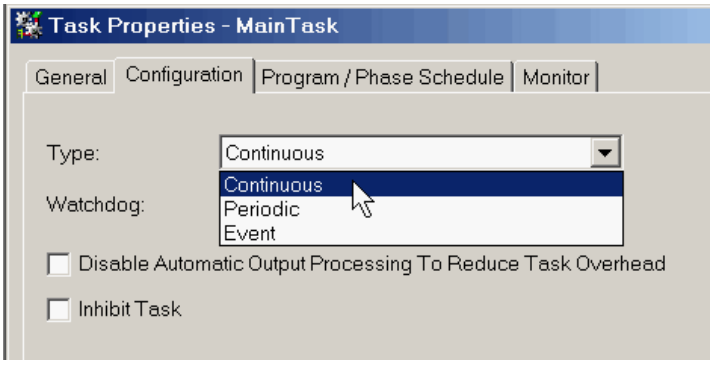


Figure 29 - Tasks



A task provides scheduling and priority information for a set of one or more programs. Configure tasks as continuous, periodic, or event using the Task Properties dialog box.

Figure 30 - Configuring the Task Type



This table explains the types of tasks you can configure.

Table 36 - Task Types and Execution Frequency

Task Type	Task Execution	Description
Continuous	All of the time	The continuous task runs in the background. Any CPU time not allocated to other operations (such as motion, communication, and other tasks) is used to execute the programs in the continuous task. • The continuous task runs constantly. When the continuous task completes a full scan, it restarts immediately. • A project does not require a continuous task. If used, there can be only one continuous task.
Periodic	• At a set interval, such as every 100 ms • Multiple times within the scan of your other logic	A periodic task performs a function at a specific interval. • Whenever the time for the periodic task expires, the task interrupts any lower priority tasks, executes once, and then returns control to where the previous task left off. • You can configure the time period from 0.1...2,000,000.00 ms. The default is 10 ms. It is also controller and configuration dependent. • The performance of a periodic task depends on the type of Logix5000 controller and on the logic in the task.
Event	Immediately when an event occurs	An event task performs a function only when a specific event (trigger) occurs. The trigger for the event task can be the following: • Module input data change of state • A consumed tag trigger • An EVENT instruction • An axis trigger • A motion event trigger

The ControlLogix controller supports up to 32 tasks, only one of which can be continuous.

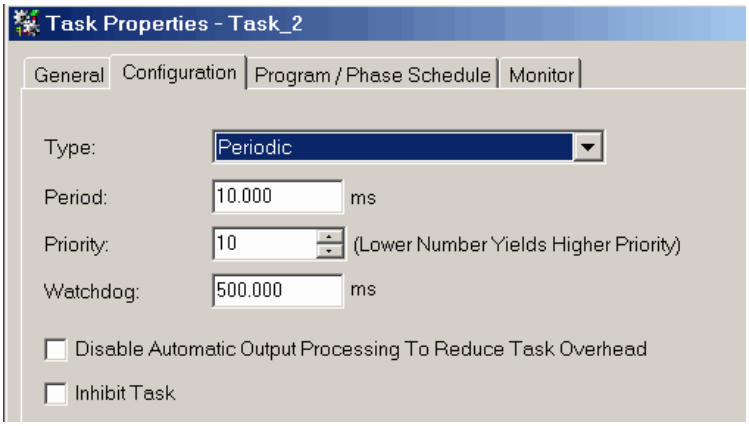
A task can have up to 100 separate programs, each with its own executable routines and program-scoped tags. Once a task is triggered (activated), all the programs assigned to the task execute in the order in which they are grouped. Programs can appear only once in the Controller Organizer and cannot be shared by multiple tasks.

Task Priority

Each task in the controller has a priority level. The operating system uses the priority level to determine which task to execute when multiple tasks are triggered. A higher priority task will interrupt any lower priority task. The continuous task has the lowest priority and is always interrupted by a periodic or event task.

You can configure periodic and event tasks to execute from the lowest priority of 15 up to the highest priority of 1. Configure the task priority using the Task Properties dialog box.

Figure 31 - Configure Task Priority



Programs

The controller operating system is a preemptive multitasking system that is IEC 1131-3 compliant. This system provides the following:

- Programs to group data and logic
- Routines to encapsulate executable code written in a single programming language

Each program contains the following:

- Program tags
- A main executable routine
- Other routines
- An optional fault routine

Figure 32 - Program within a Control Application

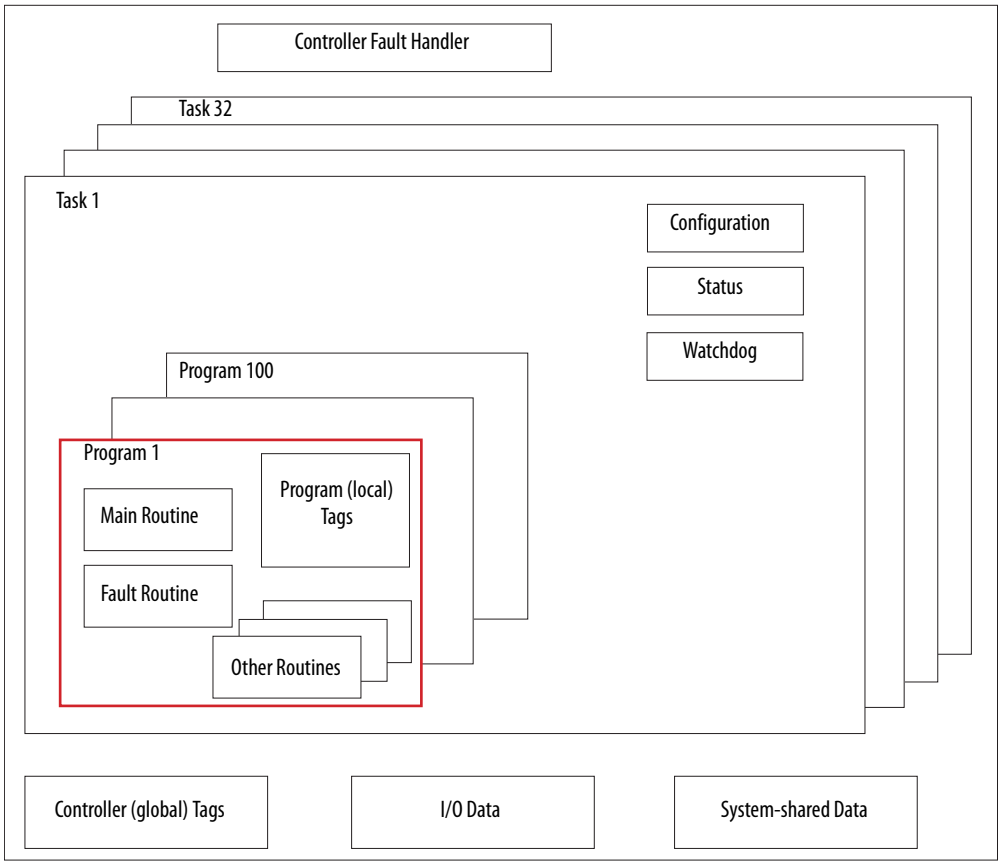
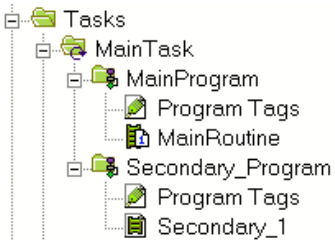


Figure 33 - Programs



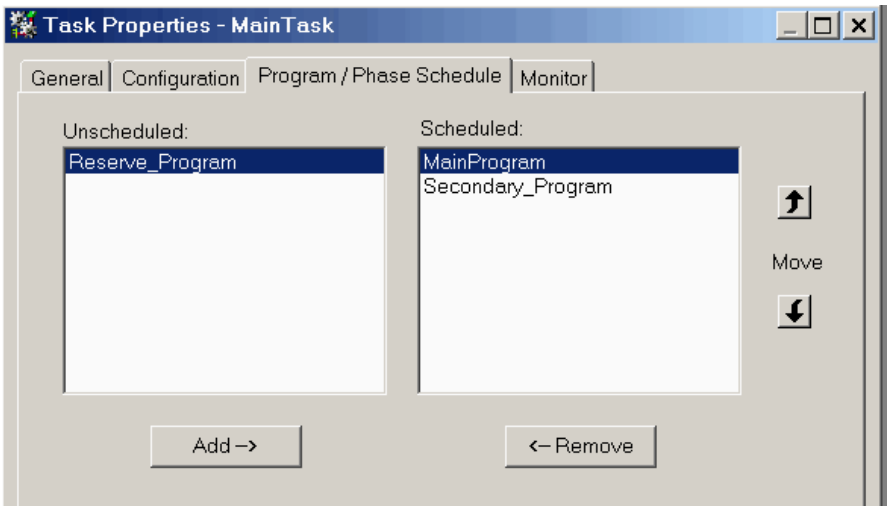
Scheduled and Unscheduled Programs

The scheduled programs within a task execute to completion from first to last. Programs that aren't attached to any task show up as unscheduled programs.

Unscheduled programs within a task are downloaded to the controller with the entire project. The controller verifies unscheduled programs but does not execute them.

You must schedule a program within a task before the controller can scan the program. To schedule an unscheduled program, use the Program/Phase Schedule tab of the Task Properties dialog box.

Figure 34 - Scheduling an Unscheduled Program



Routines

A routine is a set of logic instructions in a single programming language, such as Ladder Diagram (ladder logic). Routines provide the executable code for the project in a controller. A routine is similar to a program file or subroutine in a PLC or SLC processor.

Each program has a main routine. This is the first routine to execute when the controller triggers the associated task and calls the associated program. Use logic, such as the Jump to Subroutine (JSR) instruction, to call other routines.

You can also specify an optional program fault routine. The controller executes this routine if it encounters an instruction-execution fault within any of the routines in the associated program.

Figure 35 - Routines in a Control Application

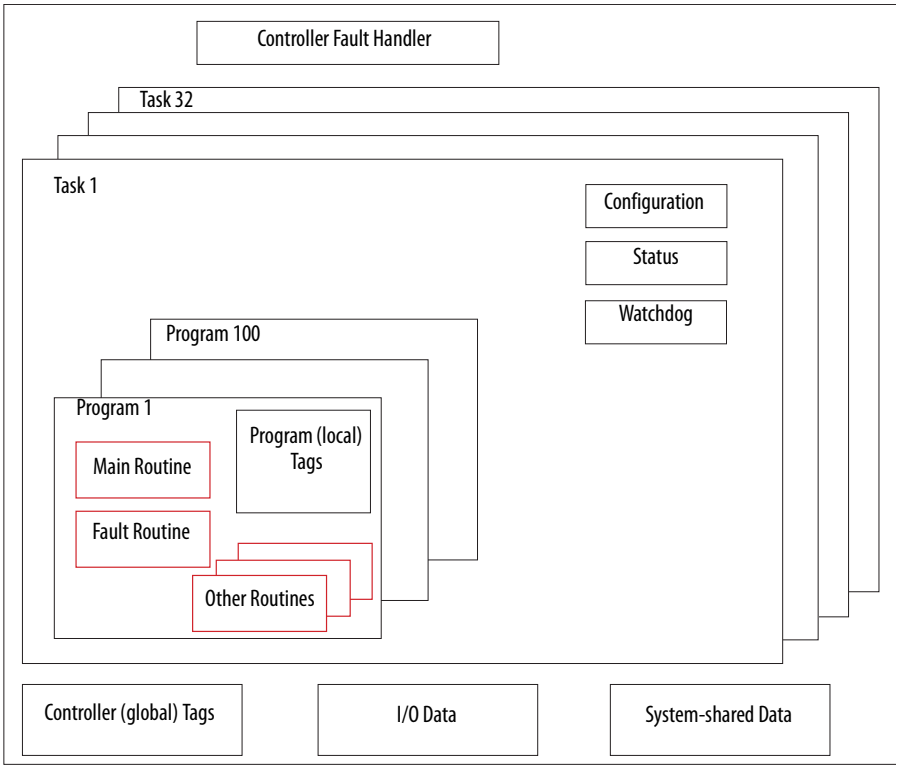
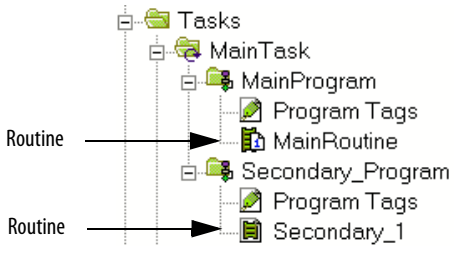


Figure 36 - Routines



Tags

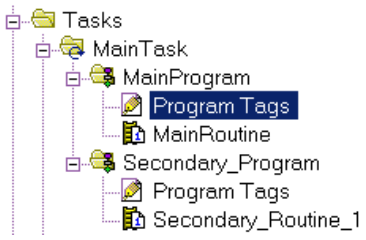
With a Logix5000 controller, you use a tag (alphanumeric name) to address data (variables). In Logix5000 controllers, there is no fixed, numeric format. The tag name identifies the data and lets you do the following:

- Organize your data to mirror your machinery.
- Document your application as you develop it.

This example shows data tags created within the scope of the Main Program of the controller.

Figure 37 - Tags Example

Controller Organizer —Main Program Tags



Program Tags Window—Main Program Tags

Scope: MainProgram Show: All Tags

	Name	Alias For	Base Tag	Data Type
Analog I/O Device	north_tank_mix			BOOL
	north_tank_pressure			REAL
	north_tank_temp			REAL
	one_shots			DINT
	recipe			TANK[3]
Integer Value	recipe_number			DINT
Storage Bit	replace_bit			BOOL
Counter	running_hours			COUNTER
Timer	running_seconds			TIMER
Digital I/O Device	start			BOOL
	stop			BOOL

There are several guidelines for creating and configuring program tags for optimal task and program execution. For more information, see the Logix5000 Controllers and I/O Tag Data Programming Manual, publication 1756-PM004.

Extended Properties

The Extended Properties feature lets you define additional information, such as limits, engineering units, or state identifiers, for various components within your controller project.

Component	Extended Properties
Tag	In the tag editor, add extended properties to a tag.
User-defined data type	In the data type editor, add extended properties to data types.
Add-On Instructions	In the properties associated with the Add-On Instruction definition, add extended properties to Add-On Instructions.

Pass-through behavior is the ability to assign extended properties at a higher level of a structure or Add-On Instruction and have that extended property automatically available for all members. Pass-through behavior is available for descriptions, state identifiers, and engineering units and is user configurable. Configure pass-through behavior on the Project tab of the Controller Properties dialog box. If you choose not to show pass-through properties, then only extended properties that have been configured for a given component are displayed.

Pass-through behavior is **not** available for limits.When an instance of a tag is created, if limits are associated with the data type, the instance is copied.

You need to know which tags have limits associated with them as there is no indication in the tag browser that extended properties are defined for a tag. If, however, you try to use extended properties that have not been defined for a tag, the editors show a visual indication and the routine does not verify.

Access Extended Properties in Logic

You can access limits defined on tags by using the .@Min and .@Max syntax:

- You cannot write to extended properties values in logic.
- To use extended tag properties in an Add-On Instruction, you must pass them in as input operands to the Add-On Instruction.
- Aliases to tags that have extended properties cannot access the extended properties in logic.
- Limits can be configured for input and output parameters in Add-On Instructions. However, limits cannot be defined on an InOut parameter of an Add-On Instruction.
- Limits cannot be accessed inside Add-On Instruction logic. Limits are for use by HMI applications only.

If an array tag is using indirect addressing to access limits in logic, the following conditions apply:

- If the array tag has limits configured, the extended properties are applied to any array element that does not explicitly have that particular extended property configured. For example, if the array tag MyArray has Max configured to 100, then any element of the array that does not have Max configured inherits the value of 100 when being used in logic. However, it will not be visible to you that the value inherited from MyArray is configured in the tag properties.

- At least one array element must a limit configured for indirectly referenced array logic to verify. For example, if MyArray[x].@Max is being used in logic, at least one array element of MyArray[] must have Max extended property configured if Max is not configured by MyArray.

- Under the following circumstances a data type default value is used:

  – Array is accessed programmatically with indirect reference.
  – Array tag does not have the extended property configured.
  – A member of an array does not have the extended property configured.

  For example, for an array of SINT type, when max limit is called in logic for a member, the value 127 will be used.

If an array element is directly accessed, the element has to have the extended property defined. If not verification will fail.

Programming Languages

The ControlLogix controller supports these programming languages, both online and offline.

Table 37 - ControlLogix Controller Programming Languages

Language	Is best used in programs with
Relay ladder	Continuous or parallel execution of multiple operations (not sequenced)
	Boolean or bit-based operations
	Complex logical operations
	Message and communication processing
	Machine interlocking
	Operations that service or maintenance personnel may have to interpret in order to troubleshoot the machine or process
Function block diagram	Continuous process and drive control
	Loop control
	Calculations in circuit flow
Sequential function chart (SFC)	High-level management of multiple operations
	Repetitive sequence of operations
	Batch process
	Motion control using structured text
	State machine operations
Structured text	Complex mathematical operations
	Specialized array or table loop processing
	ASCII string handling or protocol processing

For information about programming in these languages, see the Logix5000 Controllers Common Procedures Programming Manual, publication 1756-PM001.

Add-On Instructions

With RSLogix 5000 software, version 16.03.00 or later, and Logix Designer application, version 21.00.00 or later, you can design and configure sets of commonly used instructions to increase project consistency. Similar to the built-in instructions contained in Logix5000 controllers, these instructions you create are called Add-On Instructions. Add-On Instructions reuse common control algorithms. With them, you can do the following:

- Ease maintenance by animating logic for a single instance.
- Protect intellectual property with locking instructions.
- Reduce documentation development time.

You can use Add-On Instructions across multiple projects. You can define your instructions, obtain them from somebody else, or copy them from another project.

This table explains some of the capabilities and advantages of use Add-On Instructions.

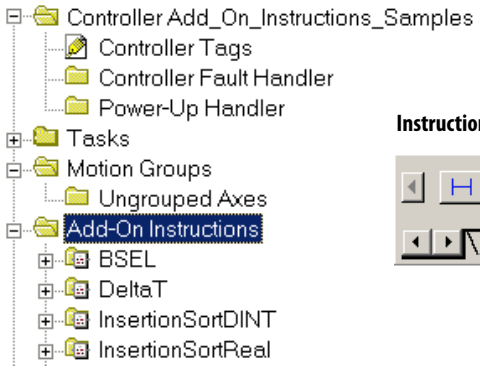
Table 38 - Add-On Instruction Capabilities

Capability	Description
Save Time	With Add-On Instructions, you can combine your most commonly used logic into sets of reusable instructions. You save time when you create instructions for your projects and then share them with others. Add-On Instructions increase project consistency because commonly used algorithms all work in the same manner, regardless of who implements the project.
Use Standard Editors	You create Add-On Instructions by using one of three programming editors: • Relay Ladder • Function Block Diagram • Structured Text
Export Add-On Instructions	You can export Add-On Instructions to other projects as well as copy and paste them from one project to another. Give each instruction a unique name so that you don't accidentally overwrite another instruction of the same name.
Use Context Views	Context views let you visualize an instruction's logic for a specific instant, simplifying online troubleshooting of your Add-On Instructions. Each instruction contains a revision, a change history, and an auto-generated help page.
Create Custom Help	When you create an instruction, you enter information for the description fields. This information then becomes custom Help.
Apply Source Protection	As the creator of Add-On Instructions, you can limit users of your instructions to read-only access, or you can bar access to the internal logic or local parameters used by the instructions. This source protection lets you prevent unwanted changes to your instructions and protects your intellectual property.

Once defined in a project, Add-On Instructions behave similarly to the built-in instructions in Logix5000 controllers. They appear on the instruction tool bar for easy access along with internal instructions.

Figure 38 - Add-On Instructions

Controller Organizer



Instruction Toolbar

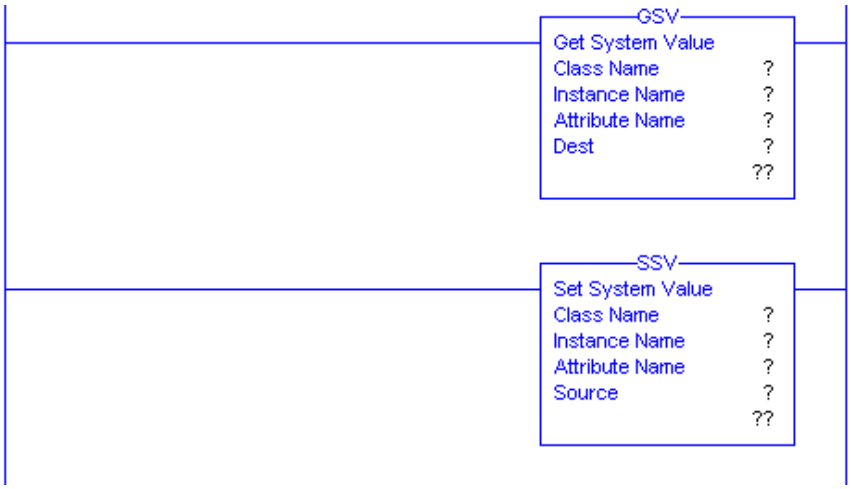
For more information about using Add-On Instructions, see the Add-On Instructions Programming Manual, publication 1756-PM010.

Monitoring Controller Status

The ControlLogix controller uses Get System Value (GSV) and Set System Value (SSV) instructions to get and set (change) controller data. The controller stores system data in objects. There is no status file, as in the PLC-5 processor.

The GSV instruction retrieves the specified information and places it in the destination. The SSV instruction sets the specified attribute with data from the source. Both instructions are available from the Input/Output tab of the Instruction toolbar.

Figure 39 - GSV and SSV Instructions for Monitoring and Setting Attributes



When you add a GSV/SSV instruction to the program, the valid object classes, object names, and attribute names for the instruction are shown. For the GSV instruction, you can get values for all the available attributes. For the SSV instruction, only the attributes you can set are shown.

Some object types appear repeatedly, so you may have to specify the object name. For example, there can be several tasks in your application. Each task has its own Task object that you access by the task name.

There are several objects and attributes that you can use the GSV and SSV instructions to monitor and set the system. For more information about GSV instructions, SSV instructions, objects, and attributes see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

Monitoring I/O Connections

If communication with a device in the controller's I/O configuration does not occur in an application-specific period of time, the communication times out and the controller produces warnings.

The minimum timeout period that, once expired without communication, causes a timeout is 100 ms. The timeout period may be greater, depending on the application's RPI. For example, if your application uses the default RPI = 20 ms, the timeout period is 160 ms.

For more information on how to determine the time for your application, search the Rockwell Automation Knowledgebase for answer ID 38535. The document is available at http://www.rockwellautomation.com/knowledgebase.

When a timeout does occur, the controller produces these warnings;

- An I/O fault status code is indicated on the status display of the 1756-L7*x* controller.
- The I/O status indicator on the front of the 1756-L6*x* controller flashes green.
- A ⚠ shows over the I/O configuration folder and over the devices that have timed out.
- A module fault code is produced, which you can access via the following:
  - The Module Properties dialog box
  - A GSV instruction

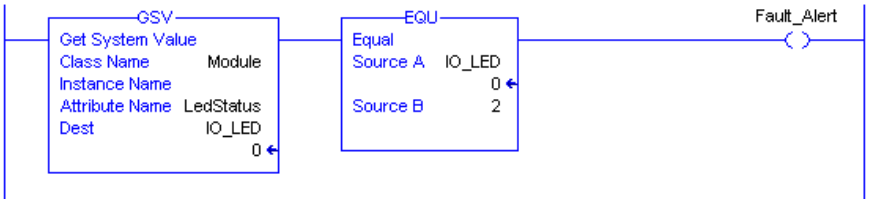
For more information about I/O faults, see the Major, Minor, and I/O Faults Programming Manual, publication 1756-PM014.

Determine if I/O Communication has Timed Out

This example can be used with either the 1756-L7*x* or 1756-L6*x* controllers:

- The GSV instruction gets the status of the I/O status indicator (via the LEDStatus attribute of the Module object) and stores it in the IO_LED tag.
- IO_LED is a DINT tag that stores the status of the I/O status indicator or status display on the front of the controller.
- If IO_LED equals 2, than at least one I/O connection has been lost and the Fault_Alert is set.

Figure 40 - GSV Used to Identify I/O Timeout



For more information about attributes available with the Module object, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

Determine if I/O Communication to a Specific I/O Module has Timed Out

If communication times out with a device (module) in the I/O configuration of the controller, the controller produces a fault code and fault information for the module. You can use GSV instructions to get fault code and information via the FaultCode and FaultInfo attributes of the Module object.

For more information about attributes available with the Module object, see the Logix5000 Controllers General Instructions Reference Manual, publication 1756-RM003.

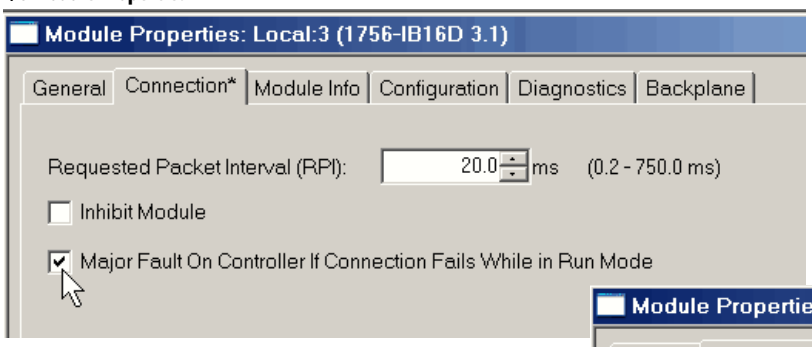
Interrupt the Execution of Logic and Execute the Fault Handler

Depending on your application, you might want an I/O connection error to cause the Controller Fault Handler to execute. To do so, set the module property that causes a major fault to result from an I/O connection error. The major fault then causes the execution of the Controller Fault Handler.

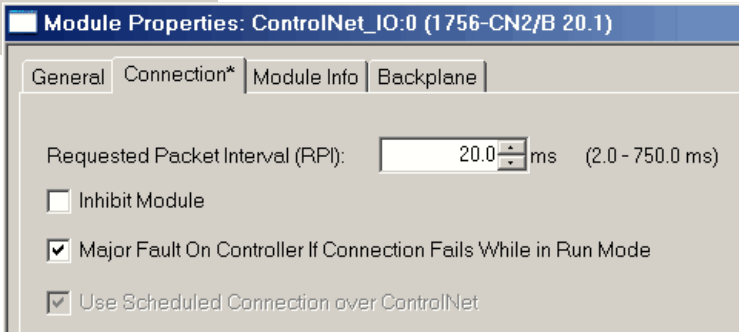
First, develop a routine in the Controller Fault Handler that can respond to I/O connection faults. Then, in the Module Properties dialog box of the I/O module or parent communication module, check Major Fault On Controller If Connection Fails While in Run Mode.

Figure 41 - I/O Connection Fault Causes Major Fault

I/O Module Properties



Parent Communication Module Properties



For more information about programming the Controller Fault Handler, see the Major, Minor, and I/O Faults Programming Manual, publication 1756-PM014.

System Overhead Time Slice

The controller communicates with other devices at either a specified rate (scheduled) or when there is processing time available to service the communication.

The system overhead time slice specifies the percentage of time a controller devotes to service communication. If you have a continuous task, the system overhead time slice entered on the Advanced tab of the Controller Properties dialog box specifies the continuous task/service communication ratio. However, if there is no continuous task, the overhead time slice has no effect.

The table shows the ratio between the continuous task and service communication at various system overhead time slices for RSLogix 5000, version 16.03.00 or later, and Logix Designer version 21.00.00 or later.

Ratio between Continuous Task and Service Communication

Time Slice	Continuous Task Duration	Service Communication Duration
10%	9 ms	1 ms
20%	4 ms	1 ms
25%	3 ms	1 ms
33%	2 ms	1 ms
50%	1 ms	1 ms
66%	1 ms	2 ms
75%	1 ms	3 ms
80%	1 ms	4 ms
90%	1 ms	9 ms

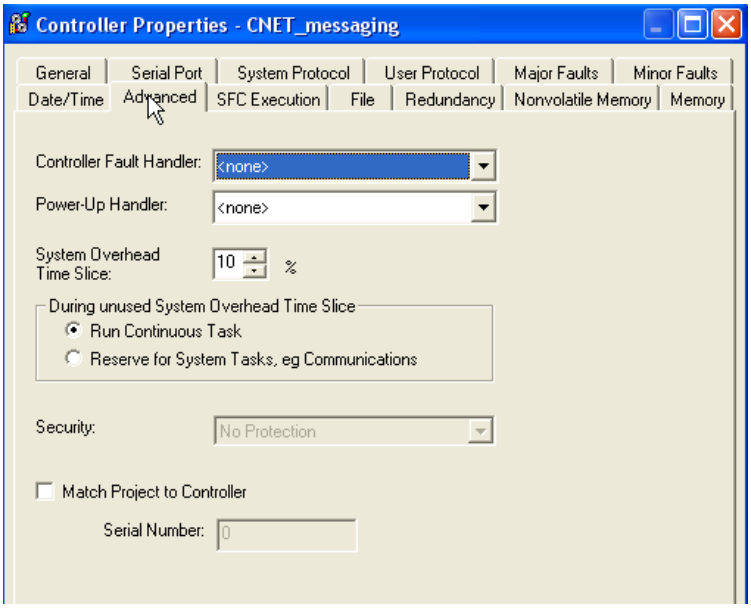
As shown in the table, if the system overhead time slice is less than or equal to 50%, the duration will stay fixed at 1 ms. The same applies for 66% and higher, except there are multiple 1 ms intervals. For example, at 66% there are two 1 ms intervals of consecutive time and at 90% there are nine 1 ms intervals of consecutive time.

Configure the System Overhead Time Slice

To configure the system overhead time slice, perform this procedure.

1. In the Controller Organizer, right-click the controller and choose Properties.

   The Controller Properties dialog box appears.

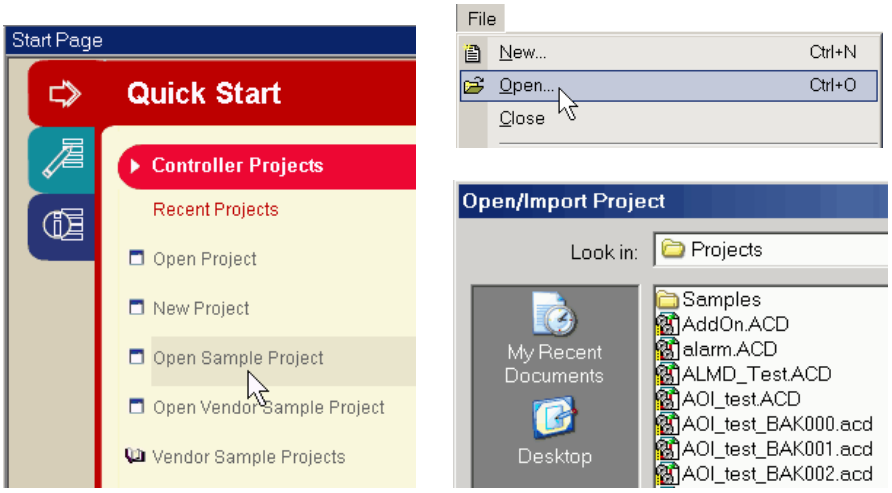


2. Click the Advanced tab.
3. Enter a numeric value in the System Overhead Time Slice box.
4. Use either Run Continuous Task (default) or Reserve for System Tasks.
   - The Run Continue Task radio button is used when there is no communication or background tasks to process; controller immediately returns to the continuous task.
   - The Reserve for System Task radio button allocates the entire 1 ms of the system overhead time slice whether the controller has communication or background tasks to perform before returning back to the continuous task. This lets you simulate a communication load on the controller during design and programming before HMIs, controller to controller messaging, and so forth, are set up.
5. Click OK.

Sample Controller Projects

Logix Designer application includes sample projects that you can copy and modify to fit your application. To access the sample projects, either choose Open Sample Project in the Quick Start menu or navigate to File > Open > Projects > Samples.

Figure 42 - Opening Sample Projects



Using the PhaseManager Tool

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State Model Overview	167
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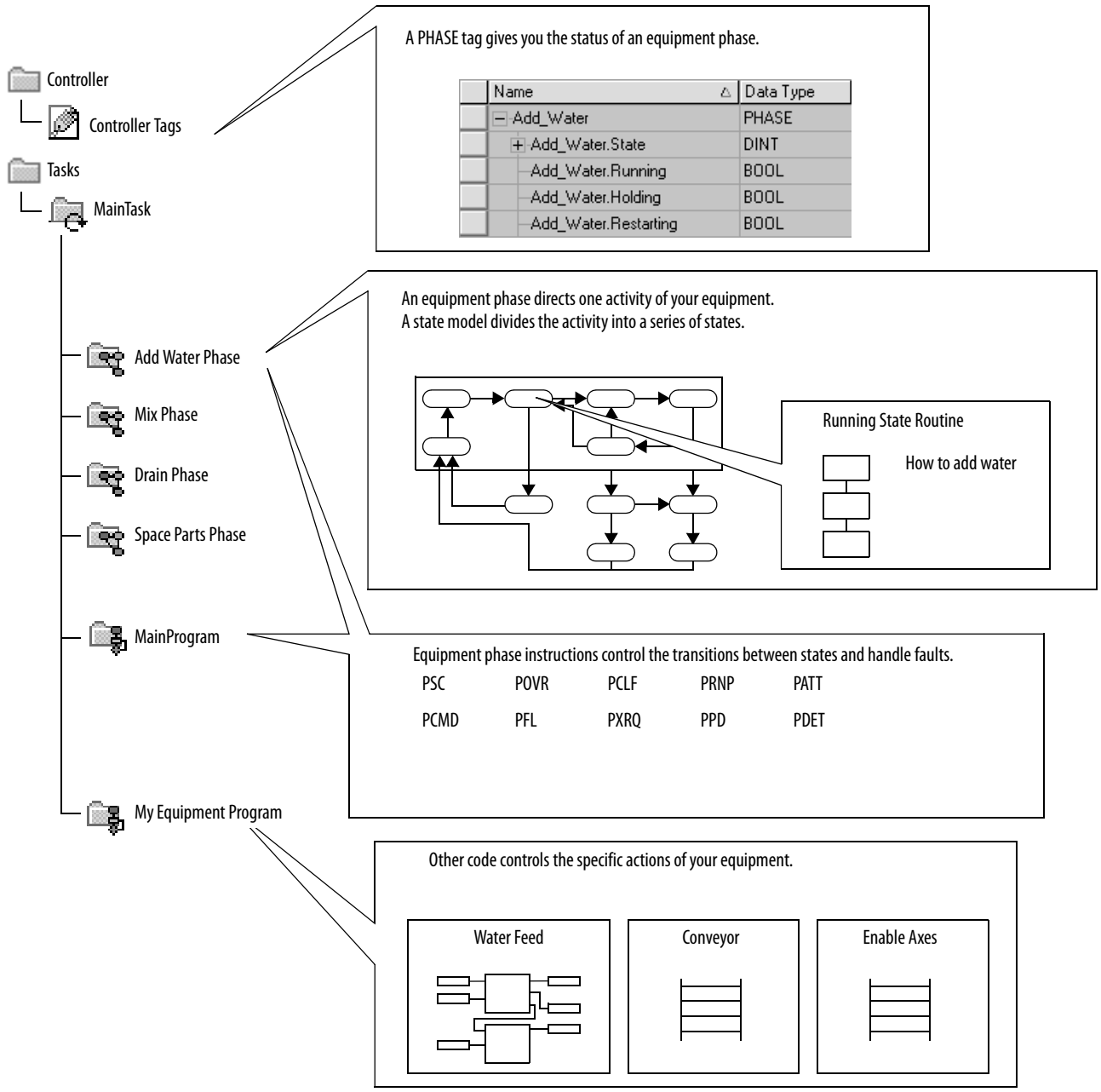
PhaseManager Overview

The PhaseManager™ tool lets you add equipment phases to your controller. An equipment phase helps you lay out your code in sections that are easier to write, find, follow, and change.

Table 39 - PhaseManager Terminology

Term	Description
Equipment phase	• As with a program, an equipment phase is run in a task and is given a set of routines and tags. • Unlike a program, an equipment phase runs by a state model and lets you do one activity.
State model	• A state model divides the operating cycle of your equipment into a series of states. Each state is an instance in the operation of the equipment, the actions, or conditions of the equipment at a given time. • The state model of an equipment phase resembles that of the S88 and Pack*ML* state models.
State machine	An equipment phase includes an embedded state machine that does the following: • Calls the routine associated with an active state • Manages the transitions between states with minimal coding • Makes sure that the equipment goes from state to state along an allowable path
PHASE tag	When you add an equipment phase, the application creates a tag for the equipment phase. The tag uses the PHASE data type.

Figure 43 - PhaseManager Overview



Minimum System Requirements

To develop PhaseManager programs, you need the following:

- A ControlLogix controller at firmware revision 16 or later
- A communication path to the controller
- RSLogix 5000 software, version 16.03.00 or later or Logix Designer application, version 21.00.00 or later

To enable PhaseManager support, you need either the Full or Professional edition of the software, or the software with PhaseManager software (catalog number 9324-RLDPMENE).

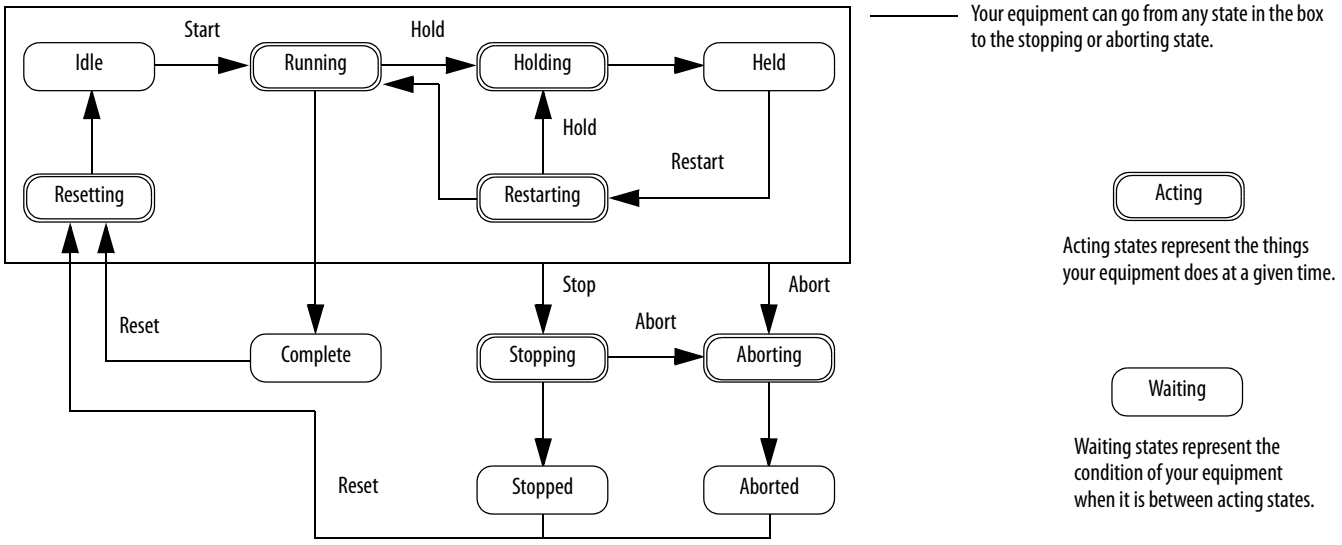
State Model Overview

A state model defines what your equipment does under different conditions, and how the states relate to each other. Each state can be described as either an Acting state or Waiting state.

Table 40 - States in PhaseManager Software

State	Description
Acting	Does something or several things for a certain time or until certain conditions are met. An acting state runs once or repeatedly.
Waiting	Shows that certain conditions are met and the equipment is waiting for the signal to go to the next state.

Figure 44 - PhaseManager State Transitions



With a state model, you define the behavior of your equipment during Acting states.

Table 41 - Acting States in the PhaseManager State Model

State	Question to Ask
Resetting	How does the equipment get ready to run?
Running	What does the equipment do to make product?
Holding	How does the equipment temporarily stop making product without making scrap?
Restarting	How does the equipment resume production after holding?
Stopping	What happens during a normal shutdown?
Aborting	How does the equipment shut down if a fault or failure occurs?

How Equipment Changes States

The state model's arrows show the states through which your equipment progresses:

- Each arrow is called a transition.
- A state model lets the equipment make only certain transitions. This restriction standardizes the equipment's behavior so that other equipment using the same model will behave the same way.

Figure 45 - PhaseManager Transition Commands

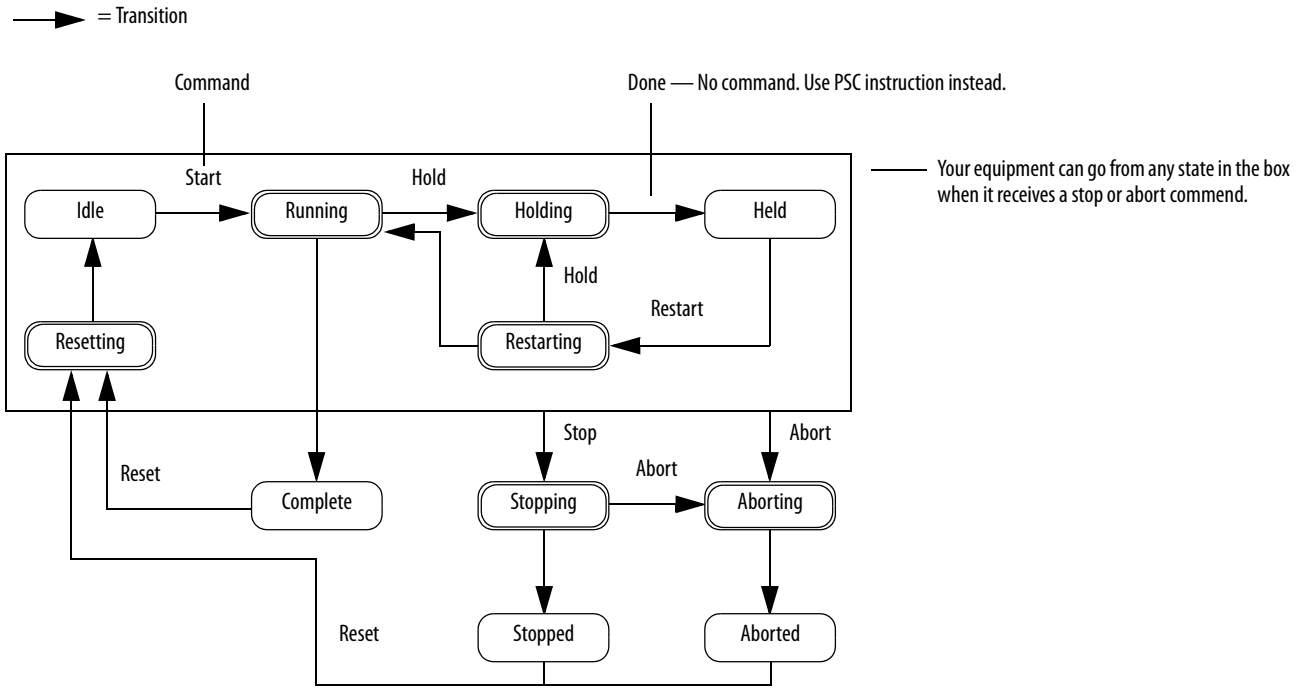


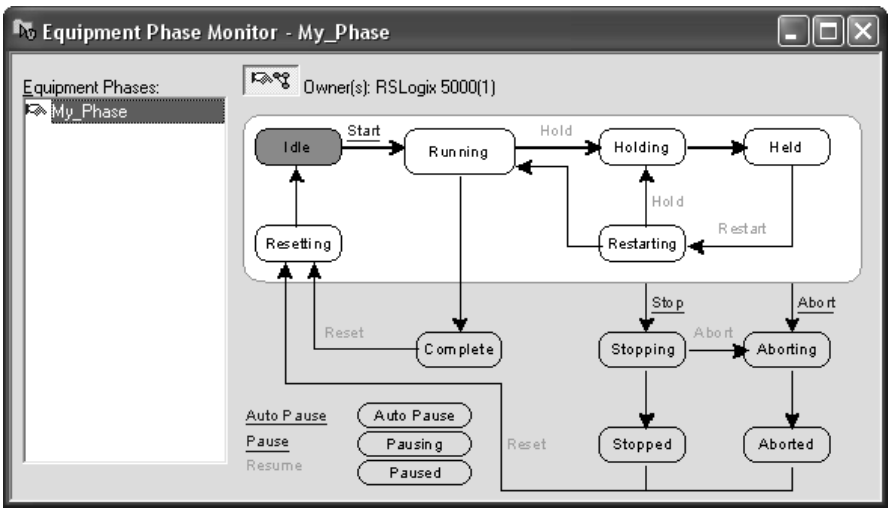
Table 42 - PhaseManager Transitions

Type of Transition	Description		
Command	A command tells the equipment to do something. For example, the operator pushes the start button to begin production and the stop button to halt production. The PhaseManager tool uses these commands:		
	Reset	Stop	Restart
	Start	Hold	Abort
Done	Equipment goes to a waiting state when it is finished with what it is doing. You do not give the equipment a command. Instead, you set up your code to signal when the phase state is finished.		
Fault	A fault tells you that something out of the ordinary has happened. You set up your code to look for faults and take action if it finds any. If you want to shut down your equipment as quickly as possible when it detects a fault, set up your code to look for that fault and give the abort command if it finds it.		

Manually Change States

You can manually change an equipment phase. To manually change a PhaseManager state, perform this procedure.

1. Open the Equipment Phase Monitor.
2. Take ownership of the equipment phase by clicking Owners and clicking Yes.
3. Click the command that initiates the state you need (for example, Start or Reset).
4. After you have finished manually changing the state, click Owners to release your ownership.



PhaseManager Tool versus Other State Models

This table compares PhaseManager state models to other state models.

Table 43 - PhaseManager Tool and Other State Models

PhaseManager Tool	S88	Pack*ML*
Resetting…Idle	Idle	Starting…Ready
Running…Complete	Running…Complete	Producing
Subroutines or breakpoints	Pausing…Paused	Standby
Holding…Held	Holding…Held	Holding…Held
Restarting	Restarting	None
Stopping…Stopped	Stopping…Stopped	Stopping…Stopped
Aborting…Aborted	Aborting…Aborted	Aborting…Aborted

Equipment Phase Instructions

The controller supports several equipment-phase relay ladder and structured text instructions.

Table 44 - Instructions for Use with PhaseManager Tool

Instruction	Instruction Function
PSC	Signal a phase that the state routine is complete and to proceed to the next state.
PCMD	Change the state or substate of a phase.
PFL	Signal a failure for a phase.
PCLF	Clear the failure code of a phase.
PXRQ	Initiate communication with RSBizWare™ Batch software.
PRNP	Clear the NewInputParameters bit of a phase.
PPD	Set up breakpoints within the logic of a phase.
PATT	Take ownership of a phase to **either** of the following: • Prevent another program or RSBizWare Batch software from commanding a phase. • Make sure another program or RSBizWare Batch software does not already own a phase.
PDET	Relinquish ownership of a phase.
POVR	Override a command.

For more information about instructions for use with equipment phases, see the PhaseManager User Manual, publication LOGIX-UM001.

Redundant Systems

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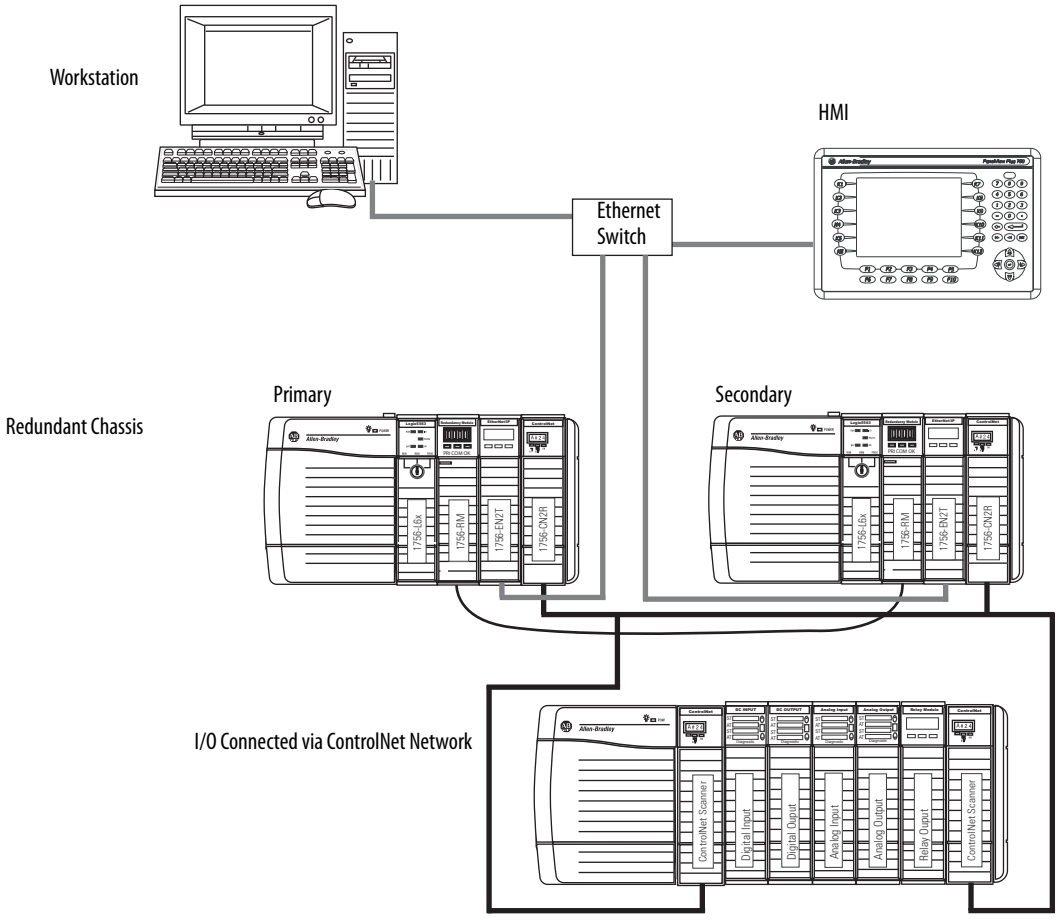
ControlLogix Redundancy Overview

Redundancy provides more system availability by switching control to a secondary controller chassis if a fault occurs in the primary controller chassis.

The redundant system switches control from the primary to the secondary when these faults occur:

- Power loss to primary chassis
- Hardware or firmware failure of any module in the primary chassis
- A major fault in the user program on the primary controller
- Loss of communication between the primary chassis and remote ControlNet or EtherNet/IP modules
- Disconnection of an Ethernet patch cable from an EtherNet/IP communication module in the primary chassis
- Removal or insertion of any module in the primary chassis
- A user command that causes a switchover

Figure 46 - ControlLogix Enhanced Redundancy System



I/O can be connected via an EtherNet/IP network beginning with Enhanced Redundancy System revision 19.50.

Redundancy requires no additional programming and is transparent to any devices connected over an EtherNet/IP or ControlNet network.

Redundancy modules placed in each redundant chassis maintain the communication between the redundant chassis.

Depending on how you organize your project, outputs may or may not experience a change in state (bump) during a switchover:

- During the switchover, outputs that are controlled by the highest priority task will experience a bumpless switchover. For example, outputs will not revert to a previous state.
- Outputs in lower priority tasks may experience a change of state.

For detailed information about ControlLogix redundancy systems, see the ControlLogix Enhanced Redundancy User Manual, publication 1756-UM535.

System Requirements

Most redundant systems must use at least these system components. For some applications, the ControlNet and EtherNet/IP modules are optional.

Table 45 - System Requirements

Quantity	Item	Notes
2	ControlLogix chassis	Both chassis must be the same size.
2	ControlLogix power supply	Must be the same in each chassis.
2	ControlLogix controller	• Use either 1756-L6*x* or 1756-L7*x* controllers. • Use the same catalog number, series, firmware revision, and memory size controllers in each chassis. • Same slot placement.
2	ControlLogix ControlNet communication module	• Use 1756-CN2/B, 1756-CN2R/B, or 1756-CN2RXT modules. • ControlNet modules in both chassis must be identical in firmware revision, in series, slot placement, and module type.
2	ControlLogix EtherNet/IP communication modules	• Use the 1756-EN2T, 1756-EN2TXT, or 1756-EN2TR modules. • Must be identical in firmware revision, slot placement and module type.
2	Redundancy module	• Use 1756-RM or 1756-RMXT modules. • Redundancy modules in both chassis must be identical in firmware revision and slot placement. • For L7x high performance systems, RM modules must be RM/B and must have the same series and firmware revision in both chassis.
1	Redundancy module cable (fiber-optic)	• Use the 1756-RMC*x* cable. • Standard lengths are available.
2	Additional ControlNet nodes	• Place all I/O in remote chassis or DIN rails. • Add at least two nodes to each ControlNet network in addition to the redundant chassis pair. • For enhanced redundancy, you must have at least one keeper-capable ControlNet device at a node address lower than the node addresses of the ControlNet modules in the redundant chassis.

System Considerations

When you are configuring a redundant ControlLogix system, these considerations specific to modules in the redundant chassis must be made.

Items in Primary and Secondary Chassis	Consideration
ControlLogix controller	• When configured for redundancy, the secondary controller automatically receives and buffers data. • A redundant controller uses twice as much data memory and I/O memory space as a nonredundant controller. • A redundant controller has a significantly longer scan time than a nonredundant controller. • The ControlLogix Enhanced Redundancy User Manual, publication 1756-UM535, provides detailed information about minimizing the scan time impact. • You do not need a redundancy-specific version of Logix Designer software, but it must match your Enhanced Redundancy System revision level.
Communication modules	• In an enhanced redundancy system, as many as seven communication modules can reside in a controller chassis in any combination of EtherNet/IP modules and ControlNet modules. • To connect to other networks, bridge through another ControlLogix chassis outside the redundant system. • For best results, use a separate networks for HMI and I/O communication.
I/O modules	• All I/O is remote from the redundant controller chassis. • Beginning with Enhanced Redundancy System revision 19.50, EtherNet/IP networks in redundant systems can be used for remote I/O or produced/consumed data.
Redundant power supplies	The 1756-PA75R and 1756-PB75R redundant power supplies provide reliable chassis power.
Redundant ControlNet media	Redundant media provide more reliable ControlNet communication.

For complete information about designing and planning modules for use in your redundant ControlLogix chassis, see the ControlLogix Enhanced Redundancy User Manual, publication 1756-UM535.

Enhanced versus Standard Redundancy

While the enhanced and standard redundancy systems operate in a similar manner, there are some key differences between the two platforms. This table compares the enhanced and standard redundancy system features.

Table 46 - Comparison of Enhanced Redundancy to Standard Redundancy

Feature	Enhanced System[1]	Standard System
Supports enhanced ControlLogix ControlNet and EtherNet/IP communication modules, for example, the 1756-CN2/B or 1756-EN2T modules	✓	
Supports standard ControlLogix ControlNet and EtherNet/IP communication modules, for example, the 1756-CNB/D or 1756-ENBT modules		✓
Compatible with the single-slot 1756-RM redundancy modules	✓	✓
Compatible with the double-slot 1757-SRM redundancy modules		✓
Support for all 1756-L6*x* and 1756-L7*x* ControlLogix controllers	✓	
Use of ControlLogix- system components, for example, the 1756-L63XT controller and the 1756-CN2XT module	✓	
Availability of I/O over an EtherNet/IP network, including Redundant I/O systems	✓	

(1) Availability of some features supported in enhanced redundancy are dependent on the system revision used. For more information, see ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535.

Build a Redundant System

To build a typical redundant system, perform this procedure.

1. Install a ControlLogix chassis and power supply.
2. To the primary chassis, add 1756-L6*x* or 1756-L7*x* controllers.

   Note that you cannot mix 1756-L6x and 1756-L7x controllers in the same chassis.
3. Add one or more ControlNet or EtherNet/IP communication modules.
4. Add one redundancy module.
5. Set up a secondary chassis that is identical to the primary chassis.

   IMPORTANT Components in the redundant chassis pair must be identical in module configuration.
6. Connect the redundancy modules in both chassis.
7. Add I/O modules to ControlNet or EtherNet/IP networks.
8. Add operator interfaces to ControlNet or EtherNet/IP networks.

For detailed information on designing and building an enhanced redundant system, refer to the ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535.

ControlNet Considerations in Redundant Systems

You can have as many as seven ControlNet communication modules in a redundant chassis.

IMPORTANT	With each ControlNet network, you must have at least two nodes external to the redundant controller chassis to avoid timeouts on switchover. The lowest node of each ControlNet network must be outside the redundant controller chassis.

For information on ControlNet considerations for enhanced redundant systems, refer to the ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535.

EtherNet/IP Considerations in Redundant Systems

You can have as many as seven EtherNet/IP modules in the redundant chassis.

In a redundant system, you can use EtherNet/IP for HMI communication or inter-controller messaging. HMI can communicate directly to with the primary controller. You no longer need RSLinx Alias Topics.

ControlLogix redundancy supports EtherNet/IP for I/O control or producing and consuming data beginning with Enhanced Redundancy System revision 19.50, and can be used for the following:

- 1715 Redundant I/O
- Remote I/O modules
- HMI connections to the primary controller
- Producing and consuming data

For information on EtherNet/IP considerations for enhanced redundant systems, refer to the ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535.

IP Address Swapping

Firmware revision 13, and later, supports IP address swapping in redundant systems. With IP address swapping, you configure the primary and secondary EtherNet/IP modules with the same IP address. The primary EtherNet/IP module takes the IP address; the secondary module takes that address plus one in the last address segment.

On a switchover, the EtherNet/IP modules swap IP addresses. HMI devices automatically continue to communicate with the new primary controller because the IP addresses were swapped. Because of the way EtherNet/IP modules work, during a switchover, communication between the controller and an HMI device halts for several seconds, typically less than a minute.

Redundancy and Scan Time

At the end of every program, the primary controller synchronizes and crossloads fresh data to the secondary controller. This keeps the secondary controller up-to-date and ready to take over. It also increases the scan time when compared to a nonredundant system.

The amount of time a crossload consumes depends on how much data the primary controller has to crossload:

- The primary controller synchronizes and crossloads any tag to which an instruction wrote a value, even the same value, since the last crossload.
- Crossloading also requires a small amount of overhead time (1 ms per crossload) to tell the secondary controller which program the primary controller is executing.

Redundancy firmware revision 16.53, or later, provides the ability to limit which programs are followed by synchronization and data crossloading. In many applications, changing this can reduce the overall impact to the task scan time by reducing the number of times a data area is synchronized. Removing a synchronization point results in 1 ms of overhead time saved, in addition to any time that was used to crossload the data.

For complete details about the scan time of a redundant system, see the ControlLogix Enhanced Redundancy System User Manual, publication 1756-UM535.

Notes:

SIL 2 Certification

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Introduction to SIL

Certain catalog numbers of the ControlLogix system are **type-approved** and certified for use in SIL2 applications according to these standards:

- IEC 61508
- IEC 61511

Approval requirements are based on the standards current at the time of certification.

These requirements consist of mean time between failures (MTBF), probability of failure, failure rates, diagnostic coverage and safe failure fractions that fulfill SIL2 criteria. The results make the ControlLogix system suitable up to, and including, SIL2. When the ControlLogix system is in the Maintenance or Programming mode, the user is responsible for maintaining a safe state.

The TÜV Rheinland Group has approved the ControlLogix system for use in up to, and including, SIL 2 safety related applications in which the de-energized state is typically considered to be the safe state.

In addition, specific configuration and programming considerations described in the Using ControlLogix in SIL2 Applications Safety Reference Manual, publication 1756-RM001, must be made.

Programming and Debugging Tool (PADT)

For support in creation of programs, the Programming and Debugging Tool (PADT) is required. The PADT for the ControlLogix system is the Logix Designer application, per IEC 61131-3, and the Using ControlLogix in SIL2 Applications Safety Reference Manual, publication 1756-RM001.

Typical SIL2 Configurations

SIL2-certified ControlLogix systems can be used in non-redundancy or redundancy configurations. For the purposes of documentation, the various levels of availability that can be achieved by using various ControlLogix system configurations are referred to as fail-safe, high-availability, or fault-tolerant.

This table lists each system configuration and the hardware that is part of the system's safety loop.

Table 47 - SIL2 Configurations and Hardware Summary

System Configuration	Safety Loop Hardware
Fail-safe Configuration on page 181	• Nonredundant controller • Nonredundant communication modules • Nonredundant remote I/O
High-availability Configuration on page 182	• Redundant controllers • Redundant communication modules • Nonredundant remote I/O
Fault-tolerant Configuration on page 183	• Redundant controllers • Redundant communication modules • Redundant remote I/O • I/O termination boards

IMPORTANT

Note that the system user is responsible the tasks listed here when any of the ControlLogix SIL2 system configurations are used:

- The setup, SIL rating, and validation of any sensors or actuators connected to the ControlLogix control system.
- Project management and functional testing.
- Programming the application and the module configuration according to the descriptions in the following chapters.

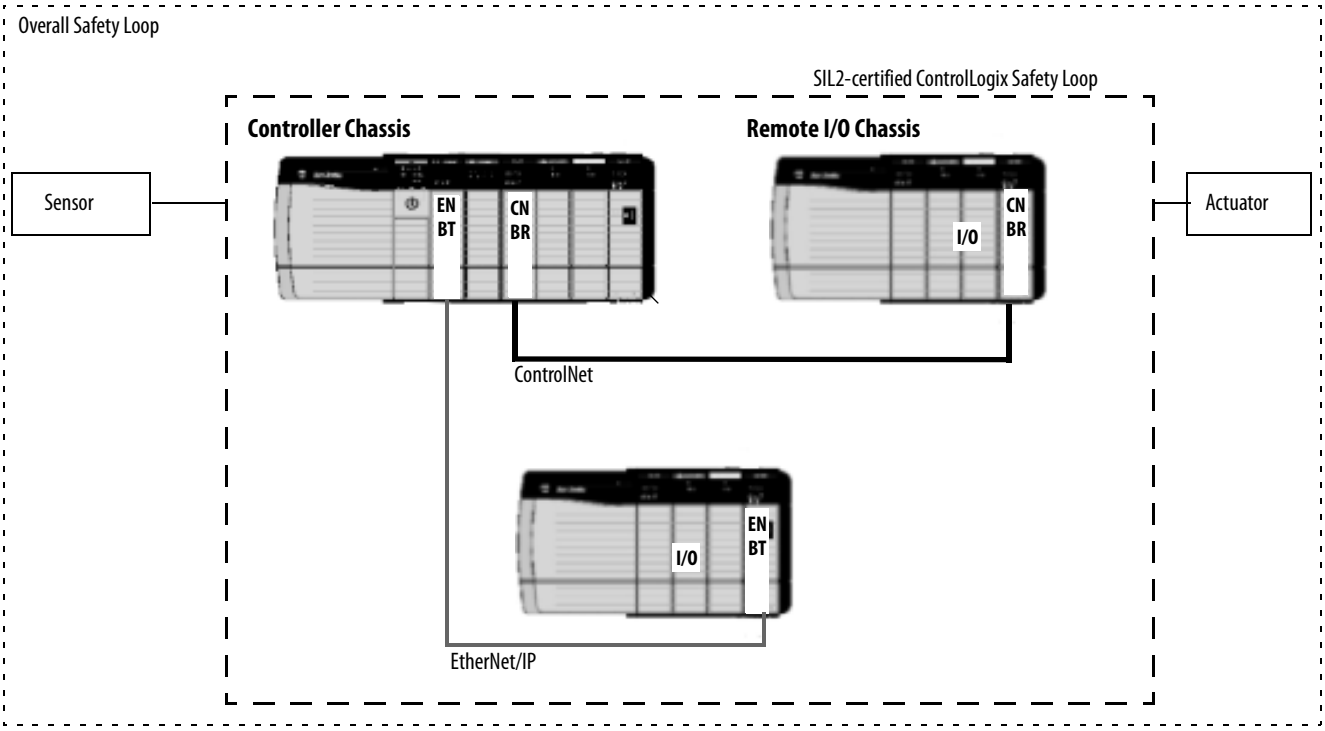
The SIL2 portion of the certified system excludes the development tools and display/human machine interface (HMI) devices; these tools and devices are not part of the safety loop.

Fail-safe Configuration

In a fail-safe configuration, the hardware used in the safety loop is not redundant. Therefore, if a fault occurs anywhere in the SIL2 system, the system is programmed to fail to safe.

The failure to safe is typically an emergency shutdown where all outputs are de-energized.

Figure 47 - Fail-safe ControlLogix Configuration



This figure shows a typical SIL loop that does not use redundancy. This figure shows the following:

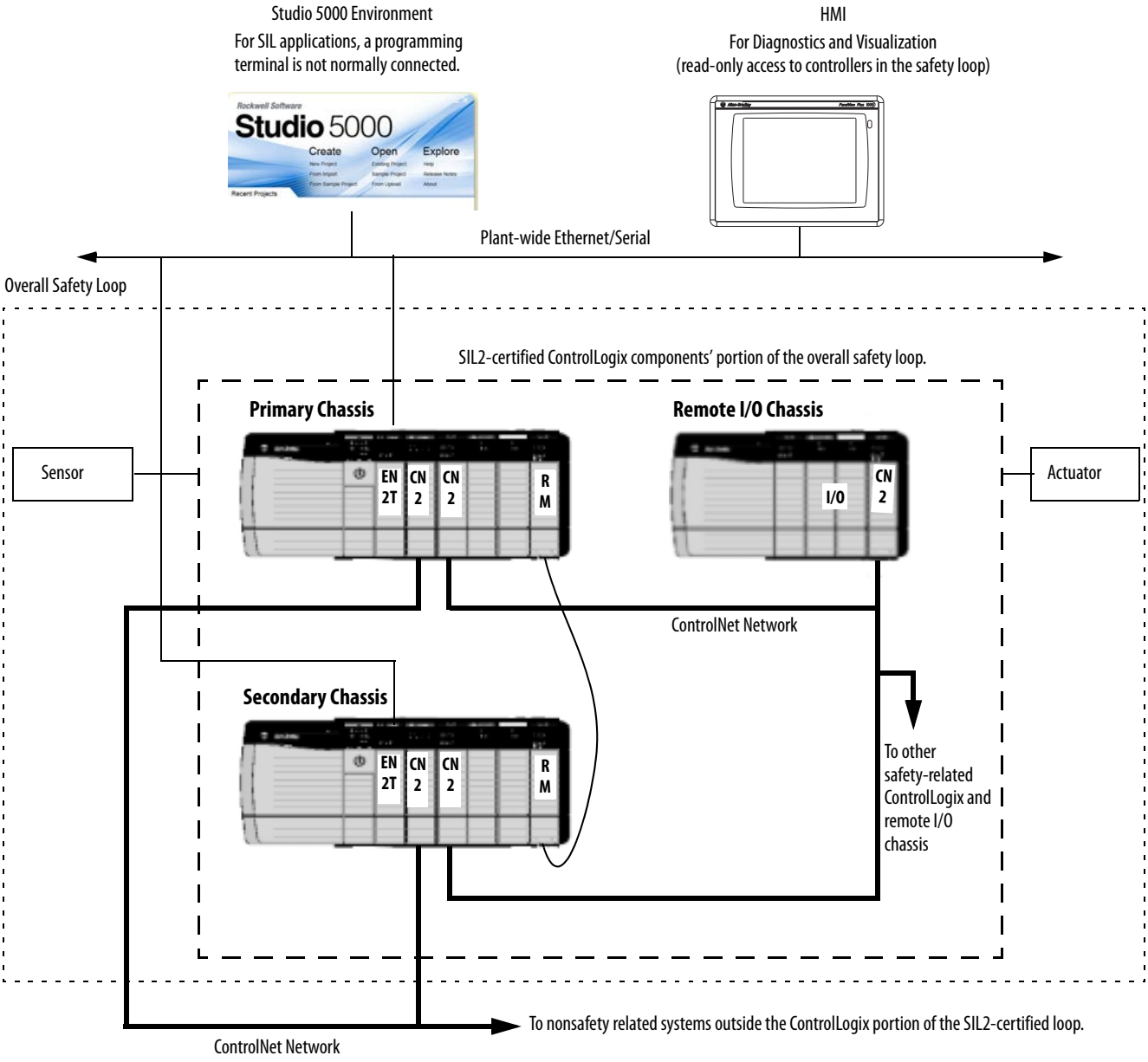
- Overall safety loop
- ControlLogix portion of the overall safety loop

TIP When certain considerations are made, it possible to connect to remote I/O via an EtherNet/IP network. To connect to remote I/O using an EtherNet/IP network, you must make considerations similar to those required for a SIL2-certified ControlNet network.

High-availability Configuration

In the high-availability configuration, redundant controller chassis are used to increase the availability of the control system. The modules in the redundant controller chassis include the redundancy modules and ControlNet modules for redundant communication, as well as the ControlLogix controllers.

Figure 48 - Typical SIL Loop with Controller Chassis Redundancy



IMPORTANT The high-availability ControlLogix system is fault-tolerant only for the devices in the primary/secondary controller chassis. The rest of the high-availability system is not considered to be fault-tolerant.

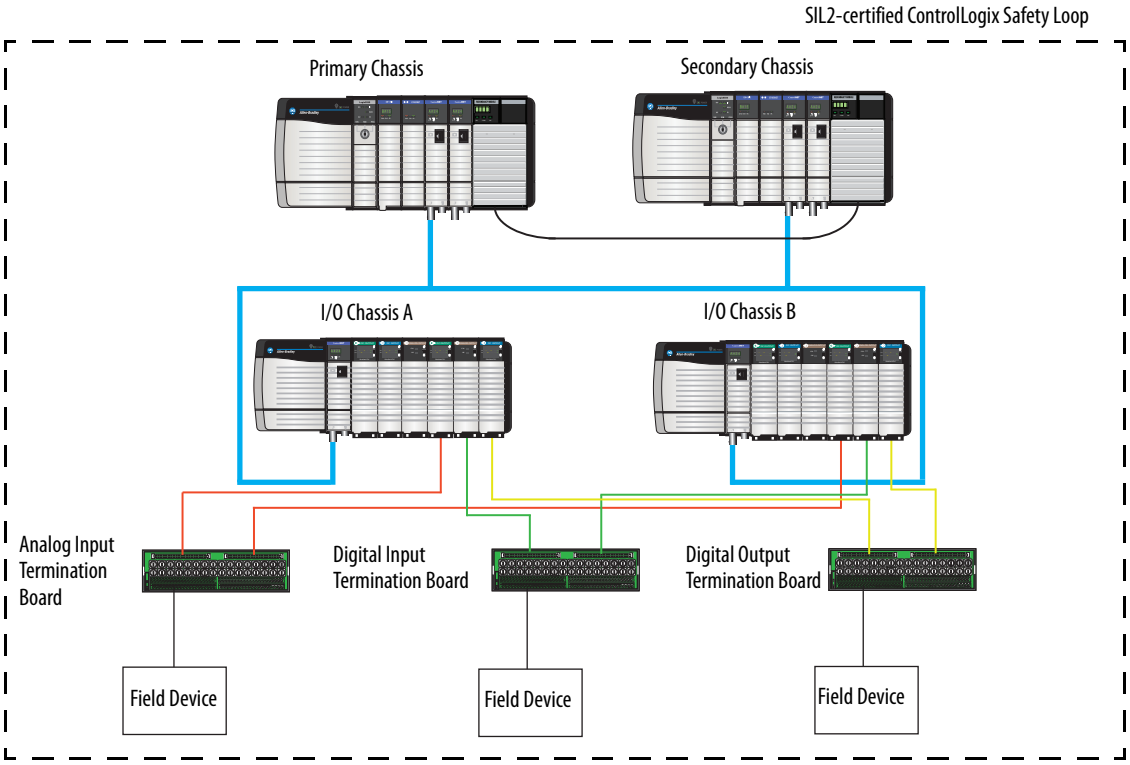
Figure 48 on page 182 shows a typical SIL loop that uses redundancy, including the following:

- The overall safety loop
- The ControlLogix portion of the overall safety loop
- How other devices (for example, HMI) connect to the loop, while operating outside the loop

Fault-tolerant Configuration

The most recently-certified ControlLogix SIL2 configuration is the fault-tolerant configuration. The fault-tolerant configuration of the ControlLogix system uses fully-redundant controllers, communication modules, and remote I/O.

Figure 49 - Fault-tolerant Configuration



The fault-tolerant configuration uses safety and programming principles described in this manual, as well as programming and hardware described in the application technique manuals.

For more information about the ControlLogix SIL2- certified fault-tolerant system, see the application technique manual that corresponds with your application.

Table 48 - ControlLogix SIL2 System Configuration Manuals

If using	Then reference this manual
SIL2 Fault-tolerant I/O subroutines	ControlLogix SIL2 System Configuration Using RSLogix 5000 Subroutines, publication 1756-AT010
SIL2 Fault-tolerant I/O Add-On Instructions	ControlLogix SIL2 System Configuration Using RSLogix 5000 Subroutines, publication 1756-AT012

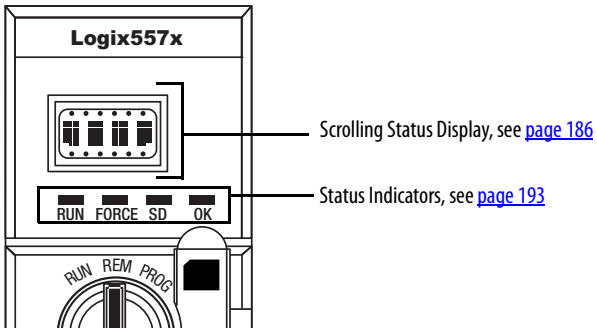
Status Indicators

Topic	Page
1756-L7x Controller Status Display and Indicators	185
1756-L7x Controller Status Display	185
1756-L7x Controller Status Indicators	193
1756-L6x Status Indicators	194

1756-L7*x* Controller Status Display and Indicators

The 1756-L7*x* controllers have four status indicators and one four-character scrolling status display.

Figure 50 - 1756-L7*x* Status Display and Indicators



1756-L7*x* Controller Status Display

The 1756-L7*x* controller status display scrolls messages that provide information about the controller's firmware revision, ESM status, project status, and major faults.

General Status Messages

The messages described in this table are typically indicated upon powerup, powerdown, and while the controller is running to show the status of the controller and the ESM.

Table 49 - General Status Messages

Message	Interpretation
No message is indicated	The controller is Off. Check the OK indicator to determine if the controller is powered and determine the state of the controller.
TEST	Power-up tests are being conducted by the controller.
PASS	Power-up tests have been successfully completed.
SAVE	A project is being saved to the SD card. You can also view the SD Indicator (see page 193) for additional status information. Allow the save to complete before: • removing the SD card. • disconnecting power.
LOAD	A project is being loaded from the SD card at controller powerup. You can also view the SD Indicator (see page 193) for additional status information. Allow the load to complete before doing the following: • Removing the SD card • Disconnecting power • Removing the ESM module
UPDT	A firmware upgrade is being conducted from the SD card upon powerup. You can also view the SD Indicator (see page 193) for additional status information. If you do not want the firmware to update upon powerup, change the controller's Load Image property.
CHRG	The capacitor-based ESM is being charged.
1756-L7*x*/*X*	The controller catalog number and series.
Rev *XX.xxx*	The major and minor revision of the controller's firmware.
No Project	No project is loaded on the controller. To load a project, do one of the following: • Use Logix Designer application to download the project to the controller • Use a SD card to load a project to the controller
Project Name	The name of the project that is currently loaded on the controller.
BUSY	The I/O modules associated with the controller are not yet fully-powered. Allow time for powerup and I/O module self-testing.
Corrupt Certificate Received	The security certificate associated with the firmware is corrupted. Go to http://www.rockwellautomation.com/support/ and download the firmware revision you are trying to upgrade to. Replace the firmware revision you have previously installed with that posted on the Technical Support website.
Corrupt Image Received	The firmware file is corrupted. Go to http://www.rockwellautomation.com/support/ and download the firmware revision you are trying to upgrade to. Replace the firmware revision you have previously installed with that posted on the Technical Support website.
ESM Not Present	An ESM is not present and the controller cannot save the application at powerdown. Insert a compatible ESM, and, if using a capacitor-based ESM, do not remove power until the ESM is charged.
ESM Incompatible	The ESM is incompatible with the memory size of the controller. Replace the incompatible ESM with a compatible ESM.
ESM Hardware Failure	A failure with the ESM has occurred and the controller is incapable of saving of the program in the event of a powerdown. Replace the ESM before removing power to the controller so the controller program is saved.
ESM Energy Low	The capacitor-based ESM does not have sufficient energy to enable the controller to save the program in the event of a powerdown. Replace the ESM.
ESM Charging	The capacitor-based ESM is charging. Do not remove power until charging is complete.

Table 49 - General Status Messages (continued)

Message	Interpretation
Flash in Progress	A firmware upgrade initiated via ControlFLASH or AutoFlash utilities is in progress. Allow the firmware upgrade to complete without interruption.
Firmware Installation Required	The controller is using boot firmware (that is revision 1.*xxx*) and requires a firmware upgrade. Upgrade controller firmware.
SD Card Locked	An SD card that is locked is installed.

Fault Messages

If the controller is faulted, these messages may be indicated on the status display.

Table 50 - Fault Messages

Message	Interpretation
Major Fault T*XX*:C*XX message*	A major fault of Type *XX* and Code *XX* has been detected. For example, if the status display indicates Major Fault T04:C42 Invalid JMP Target, then a JMP instruction is programmed to jump to an invalid LBL instruction. For details about major recoverable faults, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.
I/O Fault Local:*X #XXXX message*	An I/O fault has occurred on a module in the local chassis. The slot number and fault code are indicated along with a brief description. For example, I/O Fault Local:3 #0107 Connection Not Found indicates that a connection to the local I/O module in slot three is not open. Take corrective action specific to the type of fault indicated. For details about each I/O fault code, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.
I/O Fault *ModuleName #XXXX message*	An I/O fault has occurred on a module in a remote chassis. The name of the faulted module is indicated with the fault code and brief description of the fault. For example, I/O Fault My_Module #0107 Connection Not Found indicates that a connection to the module named My_Module is not open. Take corrective action specific to the type of fault indicated. For details about each I/O fault code, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.
I/O Fault *ModuleParent:X #XXXX message*	An I/O fault has occurred on a module in a remote chassis. The module's parent name is indicated because no module name is configured in the I/O Configuration tree of Logix Designer application. In addition, the fault code is indicated with a brief description of the fault. For example, I/O Fault My_CNet:3 #0107 Connection Not Found indicates that a connection to a module in slot 3 of the chassis with the communication module named My_CNet is not open. Take corrective action specific to the type of fault indicated. For details about each I/O fault code, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.
X I/O Faults	I/O faults are present and *X* = the number of I/O faults present. In the event of multiple I/O faults, the controller indicates the first fault reported. As each I/O fault is resolved, the number of faults indicated decreases and the next fault reported is indicated by the I/O Fault message. Take corrective action specific to the type of fault indicated. For details about each I/O fault code, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.

Major Fault Messages

Major faults are indicated by Major Fault T*XX*:C*XX message* on the controller status display. This table lists specific fault types, codes, and the associated messages as they are shown on the status display.

For detailed descriptions and suggested recovery methods for major faults, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.

Table 51 - Major Fault Status Messages

Type	Code	Message
1	1	Run Mode Powerup
1	60	Non-recoverable
1	61	Non-recoverable – Diagnostics Saved on CF Card
1	62	Non-recoverable – Diagnostics and Program Saved on SD Card
3	16	I/O Connection Failure
3	20	Chassis Failure
3	21	
3	23	Connection Failure
4	16	Unknown Instruction
4	20	Invalid Array Subscript
4	21	Control Structure LEN or POS < 0
4	31	Invalid JSR Parameter
4	34	Timer Failure
4	42	Invalid JMP Target
4	82	SFC Jump Back Failure
4	83	Value Out of Range
4	84	Stack Overflow
4	89	Invalid Target Step
4	90	Invalid Instruction
4	91	Invalid Context
4	92	Invalid Action
4	990	User-defined
4	991	
4	992	
4	993	
4	994	
4	995	
4	996	
4	997	
4	998	
4	999	

Table 51 - Major Fault Status Messages (continued)

Type	Code	Message
6	1	Task Watchdog Expired
7	40	Save Failure
7	41	Bad Restore Type
7	42	Bad Restore Revision
7	43	Bad Restore Checksum
8	1	Keyswitch Change Ignored
11	1	Positive Overtravel Limit Exceeded
11	2	Negative Overtravel Limit Exceeded
11	3	Position Error Tolerance Exceeded
11	4	Encoder Channel Connection Fault
11	5	Encoder Noise Event Detected
11	6	SERCOS Drive Fault
11	7	Synchronous Connection Fault
11	8	Servo Module Fault
11	9	Asynchronous Connection Fault
11	10	Motor Fault
11	11	Motor Thermal Fault
11	12	Drive Thermal Fault
11	13	SERCOS Communications Fault
11	14	Inactive Drive Enable Input Detected
11	15	Drive Phase Loss Detected
11	16	Drive Guard Fault
11	32	Motion Task Overlap Fault
11	33	CST Reference Loss Detected
18	1	CIP Motion Initialization Fault
18	2	CIP Motion Initialization Fault Mfg
18	3	CIP Motion Axis Fault
18	4	CIP Motion Axis Fault Mfg
18	5	CIP Motion Fault
18	6	CIP Module Fault
18	7	Motion Group Fault
18	8	CIP Motion Configuration Fault
18	9	CIP Motion APR Fault
18	10	CIP Motion APR Fault Mfg
18	128	CIP Motion Guard Fault

I/O Fault Codes

I/O faults indicated by the controller are indicated on the status display in one of these formats:

- I/O Fault Local:*X #XXXX message*
- I/O Fault *ModuleName #XXXX message*
- I/O Fault *ModuleParent*:*X #XXXX message*

The first part of the format is used to indicate the location of the faulted module. How the location is indicated depends on your I/O configuration and the module's properties specified in Logix Designer application.

The latter part of the format, #XXXX message, can be used to diagnose the type of I/O fault and potential corrective actions. For details about each I/O fault code, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.

Table 52 - I/O Fault Messages

Code	Message
#0001	Connection Failure
#0002	Insufficient Resource
#0003	Invalid Value
#0004	IOI Syntax
#0005	Destination Unknown
#0006	Partial Data Transferred
#0007	Connection Lost
#0008	Service Unsupported
#0009	Invalid Attribute Value
#000A	Attribute List Error
#000B	State Already Exists
#000C	Object Mode Conflict
#000D	Object Already Exists
#000E	Attribute Not Settable
#000F	Permission Denied
#0010	Device State Conflict
#0011	Reply Too Large
#0012	Fragment Primitive
#0013	Insufficient Command Data
#0014	Attribute Not Supported
#0015	Data Too Large
#0100	Connection In Use
#0103	Transport Not Supported
#0106	Ownership Conflict
#0107	Connection Not Found

Table 52 - I/O Fault Messages (continued)

Code	Message
#0108	Invalid Connection Type
#0109	Invalid Connection Size
#0110	Module Not Configured
#0111	RPI Out of Range
#0113	Out of Connections
#0114	Wrong Module
#0115	Wrong Device Type
#0116	Wrong Revision
#0117	Invalid Connection Point
#0118	Invalid Configuration Format
#0119	Module Not Owned
#011A	Out of Connection Resources
#0203	Connection Timeout
#0204	Unconnected Message Timeout
#0205	Invalid Parameter
#0206	Message Too Large
#0301	No Buffer Memory
#0302	Bandwidth Not Available
#0303	No Bridge Available
#0304	ControlNet Schedule Error
#0305	Signature Mismatch
#0306	CCM Not Available
#0311	Invalid Port
#0312	Invalid Link Address
#0315	Invalid Segment Type
#0317	Connection Not Scheduled
#0318	Invalid Link Address
#0319	No Secondary Resources Available
#031E	No Available Resources
#031F	No Available Resources
#0800	Network Link Offline
#0801	Incompatible Multicast RPI
#0814	Data Type Mismatch
#FD01	Bad Backplane EEPROM
#FD02	No Error Code
#FD03	Missing Required Connection
#FD04	No CST Master
#FD05	Axis or GRP Not Assigned
#FD06	SERCOS Transition Fault

Table 52 - I/O Fault Messages (continued)

Code	Message
#FD07	SERCOS Init Ring Fault
#FD08	SERCOS Comm Fault
#FD09	SERCOS Init Node Fault
#FD0A	Axis Attribute Reject
#FD1F	Safety I/O
#FD20	No Safety Task
#FE01	Invalid Connection Type
#FE02	Invalid Update Rate
#FE03	Invalid Input Connection
#FE04	Invalid Input Data Pointer
#FE05	Invalid Input Data Size
#FE06	Invalid Input Force Pointer
#FE07	Invalid Output Connection
#FE08	Invalid Output Data Pointer
#FE09	Invalid Output Data Size
#FE0A	Invalid Output Force Pointer
#FE0B	Invalid Symbol String
#FE0C	Invalid Scheduled P/C Instance
#FE0D	Invalid Symbol Instance
#FE0E	Module Firmware Updating
#FE0F	Invalid Firmware File Revision
#FE10	Firmware File Not Found
#FE11	Firmware File Invalid
#FE12	Automatic Firmware Update Failed
#FE13	Update Failed - Active Connection
#FE14	Searching Firmware File
#FE22	Invalid Connection Type
#FE23	Invalid Unicast Allowed
#FF00	No Connection Instance
#FF01	Path Too Long
#FF04	Invalid State
#FF08	Invalid Path
#FF0B	Invalid Config
#FF0E	No Connection Allowed

1756-L7*x* Controller Status Indicators

The status indicators are below the status display on the controller. They indicate the state of the controller as described in these tables.

RUN Indicator

To change the controller mode indicated by the RUN indicator, either use the mode switch on the front of the controller or use the Controller Status menu in the Logix Designer application.

Table 53 - RUN Indicator

State	Description
Off	The controller is either in Program or Test mode.
Steady green	The controller is in Run mode.

FORCE Indicator

The Force indicator shows if I/O forces are enabled on the controller.

Table 54 - FORCE Indicator

State	Description
Off	No tags contain I/O force values.
Solid amber	I/O forces are active (enabled) though I/O force values may or may not be configured. **Use caution if you install (add) a force. If you install (add) a force, it immediately takes effect.**
Flashing amber	One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled. **Use caution if you enable I/O forces. If you enable I/O forces, all existing I/O forces also take effect.**

SD Indicator

The SD indicator shows if the Secure Digital (SD) card is in use.

Table 55 - SD Indicator

State	Description
Off	No activity is occurring with the SD card.
Flashing green	The controller is reading from or writing to the SD card. Do not remove the SD card while the controller is reading or writing.
Solid green	
Flashing red	The SD card does not have a valid file system.
Solid red	The SD card is not recognized by the controller.

OK Indicator

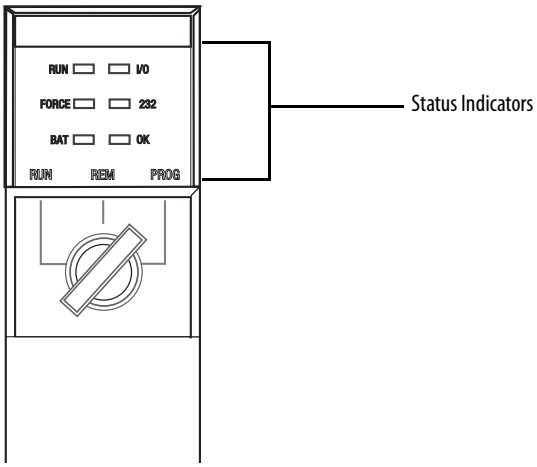
The OK indicator shows the state of the controller.

Table 56 - OK Indicator

State	Description
Off	No power is applied to the controller.
Flashing red	Either of the following is true: • It is a new controller, just out of the box, and it requires a firmware upgrade. If a firmware upgrade is required, the status display indicates Firmware Installation Required. To upgrade firmware, see Upgrade Controller Firmware on page 50. • It is a previously-used or in-use controller and a major fault has occurred. For details about major recoverable and nonrecoverable faults, see the Logix5000 Major, Minor, and I/O Fault Codes Programming Manual, publication 1756-PM014.
Solid red	One of the following is true: • The controller is completing power-up diagnostics • The charge of the capacitor in the ESM is being discharged upon powerdown. • The controller is powered, but is inoperable. • The controller is loading a project to nonvolatile memory.
Solid green	The controller is operating normally.

1756-L6*x* Status Indicators

The 1756-L6*x* controllers have status indicators on the front of the controller at show the state of the controller.



RUN Indicator

To change the controller mode indicated by the RUN indicator, either use the mode switch on the front of the controller or use the Controller Status menu in the Logix Designer application.

Table 57 - RUN Indicator

State	Description
Off	The controller is either in Program or Test mode.
Steady green	The controller is in Run mode.

I/O Indicator

The I/O indicator shows the status of I/O modules in the controller's project.

Table 58 - I/O Indicator

State	Description
Off	Either of the following is true: • There are no devices are in the I/O configuration of the controller. If needed, add the required devices to the I/O configuration of the controller. • The controller does not contain a project (controller memory is empty). If prepared, download the project to the controller.
Solid green	The controller is communicating with all of the devices in its I/O configuration.
Flashing green	One or more devices in the I/O configuration of the controller are not responding. For more information, go online with the Logix Designer application to check the I/O configuration of the controller.
Flashing red	A chassis fault exists. Troubleshoot the chassis and replace it if necessary.

FORCE Indicator

The FORCE indicator shows if I/O forces are active or enabled.

Table 59 - FORCE Indicator

State	Description
Off	Either of the following is true: • No tags contain I/O force values. • I/O forces are inactive (disabled).
Steady amber	I/O forces are active (enabled) though I/O force values may or may not be configured. **Use caution if you install (add) a force. If you install (add) a force, it immediately takes effect.**
Flashing amber	One or more input or output addresses have been forced to an On or Off state, but the forces have not been enabled. **Use caution if you enable I/O forces. If you enable I/O forces, all existing I/O forces also take effect.**

RS232 Indicator

The RS232 indicator shows if the serial port is in use.

Table 60 - RS232 Status Indicator

State	Description
Off	There is no serial connection activity.
Flashing green	There is serial connection activity.

BAT Indicator

The BAT indicator shows the charge of the battery and if the program is being saved.

Table 61 - BAT Indicator

State	Controller Series	Description
Off	N/A	The controller is able to support memory.
Solid green	A	The series A controllers do not use this state.
	B	The series B controller is conducting a save of the program to internal-nonvolatile memory during a controller power down.
Solid red	N/A	Either of the following is true: • A battery is not installed. • The battery is 95% discharged and should be replaced. Note that if the indicator is solid red before a power down, the indicator remains red while the controller is completing a program save to internal-nonvolatile memory.

OK Indicator

The OK indicator shows the state of the controller.

Table 62 - OK Indicator

State	Description
Off	No power is applied to the controller.
Flashing red	Either of the following is true: • It is a new controller, just out of the box, and it requires a firmware upgrade. • It is a previously-used or in-use controller and a major fault has occurred. • The controller is experiencing a non-recoverable, major fault.
Steady red	• A nonrecoverable major fault occurred and the program was cleared from memory. • The controller is completely powered up, in diagnostics mode. • The controller is powered, but inoperable.
Steady green	The controller is operating normally.
Flashing green	The controller is storing or loading a project to or from nonvolatile memory. If using a CompactFlash card, leave the card in the controller until the OK status indicator turns solid green.

Using Electronic Keying

Topic	Page
Electronic Keying	197
Exact Match	198
Compatible Keying	199
Disabled Keying	201

Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the RSLogix 5000 I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected.

For each module in the I/O Configuration tree, the user-selected keying option determines if, and how, an electronic keying check is performed. Typically, three keying option are available:

- Exact Match
- Compatible Keying
- Disable Keying

You must carefully consider the benefits and implications of each keying option when selecting between them. For some specific module types, fewer options are available.

Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

Table 63 - Keying Attributes

Attribute	Description
Vendor	The manufacturer of the module, for example, Rockwell Automation/Allen-Bradley.
Product Type	The general type of the module, for example, communication adapter, AC drive, or digital I/O.
Product Code	The specific type of module, generally represented by its catalog number, for example, 1756-IB16I.
Major Revision	A number that represents the functional capabilities and data exchange formats of the module. Typically, although not always, a later, that is higher, Major Revision supports at least all of the data formats supported by an earlier, that is lower, Major Revision of the same catalog number and, possibly, additional ones.
Minor Revision	A number that indicates the module's specific firmware revision. Minor Revisions typically do not impact data compatibility but may indicate performance or behavior improvement.

You can find revision information on the General tab of a module's Properties dialog box.

Figure 51 - General Tab

IMPORTANT	Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Exact Match

Exact Match keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication. If any attribute does not match precisely, I/O communication is not permitted with the module or with modules connected through it, as in the case of a communication module.

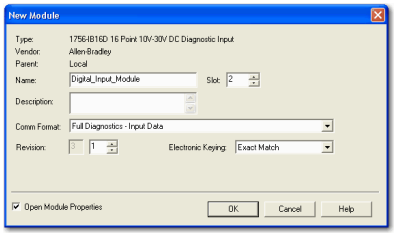
Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic

Firmware Update for the module via the Firmware Supervisor feature from a Logix5000 controller.

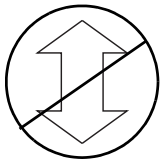
EXAMPLE In the following scenario, Exact Match keying prevents I/O communication.

The module configuration is for a 1756-IB16D module with module revision 3.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is prevented because the Minor Revision of the module does not match precisely.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 1

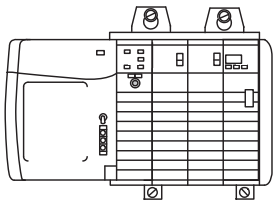


Communication is prevented.



Physical Module

Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



IMPORTANT Changing electronic keying selections online may cause the I/O Communication connection to the module to be disrupted and may result in a loss of data.

Compatible Keying

Compatible Keying indicates that the module determines whether to accept or reject communication. Different module families, communication adapters, and module types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products.

Compatible Keying is the default setting. Compatible Keying allows the physical module to accept the key of the module configured in the software, provided that the configured module is one the physical module is capable of emulating. The exact level of emulation required is product and revision specific.

With Compatible Keying, you can replace a module of a certain Major Revision with one of the same catalog number and the same or later, that is higher, Major Revision. In some cases, the selection makes it possible to use a replacement that is a different catalog number than the original. For example, you can replace a

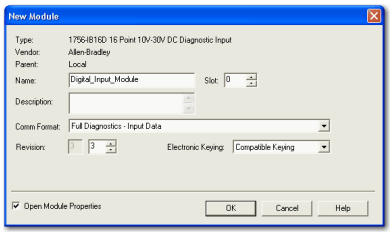
1756-CNBR module with a 1756-CN2R module. The release notes for individual modules indicate the specific compatibility details.

When a module is created, the module developers consider the module's development history to implement capabilities that emulate those of the previous module. However, the developers cannot know future developments. Because of this, when a system is configured, we recommend that you configure your module using the earliest, that is, lowest, revision of the physical module that you believe will be used in the system. By doing this, you can avoid the case of a physical module rejecting the keying request because it is an earlier revision than the one configured in the software.

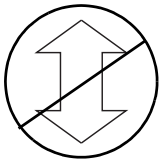
EXAMPLE In the following scenario, **Compatible Keying prevents I/O communication**.

The module configuration is for a 1756-IB16D module with module revision 3.3. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is prevented because the minor revision of the module is lower than expected and may not be compatible with 3.3.

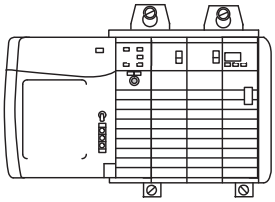
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 3



Communication is prevented.

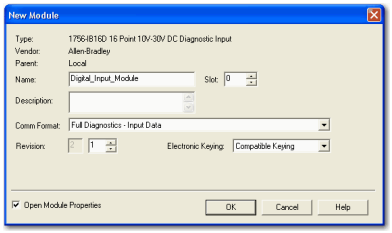


Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2

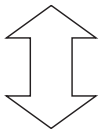


EXAMPLE In the following scenario, **Compatible Keying allows I/O communication**: The module configuration is for a 1756-IB16D module with module revision 2.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is allowed because the major revision of the physical module is higher than expected and the module determines that it is compatible with the prior major revision.

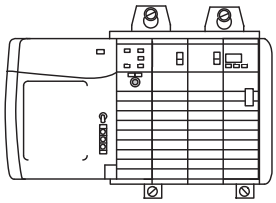
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 2
Minor Revision = 1



Communication is allowed.



Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



IMPORTANT Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Disabled Keying

Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module. Other attributes, such as data size and format, are considered and must be acceptable before I/O communication is established. With Disabled Keying, I/O communication may occur with a module other than the type specified in the I/O Configuration tree with unpredictable results. We generally do not recommend using Disabled Keying.

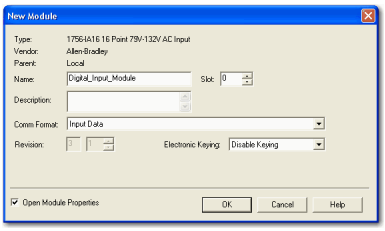
ATTENTION: Be extremely cautious when using Disabled Keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

If you use Disabled Keying, you must take full responsibility for understanding whether the module being used can fulfill the functional requirements of the application.

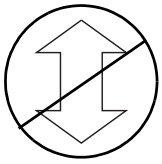
EXAMPLE In the following scenario, **Disable Keying prevents I/O communication**.

The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IF16 analog input module. In this case, **communication is prevented because the analog module rejects the data formats that the digital module configuration requests**.

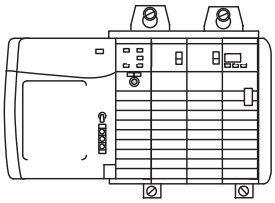
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 3
Minor Revision = 1



Communication is prevented.



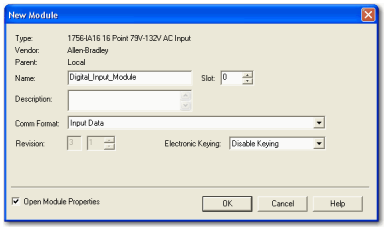
Physical Module
Vendor = Allen-Bradley
Product Type = Analog Input Module
Catalog Number = 1756-IF16
Major Revision = 3
Minor Revision = 2



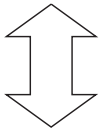
EXAMPLE In the following scenario, **Disable Keying allows I/O communication**.

The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IB16 digital input module. In this case, communication is allowed because the two digital modules share common data formats.

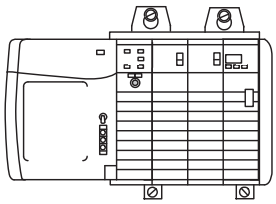
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 2
Minor Revision = 1



Communication is allowed.



Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16
Major Revision = 3
Minor Revision = 2



IMPORTANT Changing electronic keying selections online may cause the I/O communication connection to the module to be disrupted and may result in a loss of data.

Notes:

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This appendix summarizes the revisions to this manual. Reference this appendix if you need information to determine what changes have been made across multiple revisions. This may be especially useful if you are deciding to upgrade your hardware or software based on information added with previous revisions of this manual.

1756-UM001M-EN-P, February 2012

Change
Added USB cable text.
Added energy storage module information relating to safety and extreme temperature controllers.
Added parts not included with the 1756-L6*x* controller.
Added double data rate (DDR) communication reference for 1756-L7*x* controller.
Added 1756-L71, 1756-L73XT controllers and chassis and changed version information for 1756-L72, 1756-L73, 1756-L74, and 1756-L75 controllers.
Added upgrade restrictions.
Added information about mode switch operation on the controller.
Controller mode can be changed in the Logix Designer application.
Changed 1756-ESMNSE µjoules from 200…40.
Added 1756-L71 information to ControlLogix controller features.
Added 1756-L71 and 1756-L73XT memory options.
Added double data rate (DDR) communication information.
Added 1756-A7XT chassis information.
Added information about the flashing red OK status indicator for nonrecoverable faults.

1756-UM001L-EN-P, November 2011

Change
Added 1756-ESMNSE stored energy depletion rate.
Added how to uninstall the ESM.

1756-UM001K-EN-P, May 2011

Change
Added information about new 1756-L72 and 1756-L74 controllers.
Added series A information for the 1756-L72 and 1756-L74 controllers.
Added 1756-L72 and 1756-L74 controller memory size information.
Added 1756-L72 and 1756-L74 to list of controllers that support redundancy.
Added information about redundant systems and the EtherNet/IP network.

1756-UM001J-EN-P, July 2010

Change
Added 1756-L6*x* and 1756-L7*x* installation information.
Added information to identify and describe common start-up tasks completed with ControlLogix controllers.
Updated the ControlLogix example configurations, system design information, controller features descriptions to include the 1756-L7*x* controllers, available memory options to include the 1756-L7*x* information, and ControlLogix controller CPU resources.
Reformatted information for clarity on communication networks and updated the additional resources.
Placed and reformatted information specific to the use of serial communication.
Reformatted information about controller connections.
Added a list of modules and devices that can be added while online with the Logix Designer application, updated ControlNet network considerations that must be made when adding modules or devices while online, and updated EtherNet/IP network considerations that must be made when adding modules or devices while online.
Updated motion information and references with regard to the 1756-L60M03SE combination controller and reformatted and added graphics.
Made redundancy information corrections and updated information about SIL2 certification and configurations.
Added 1756-L7*x* status display and status indicator information.

1756-UM001I-EN-P, January 2007

Change
Added new information about broadcasting over serial ports.
Updated redundancy information.
Updated battery information.
Added new and updated EtherNet/IP motion information.

1756-UM001H-EN-P, July 2008

Change
Added new information about the 1756-L65 controller .
Added new information about the 1784-CF128 CompactFlash card.

1756-UM001G-EN-P, January 2007

Change
Added information about the 1756-L64 ControlLogix controller.
Added information about Add-On Instructions.
Updated the Select a System Overhead Percentage section.
Updated the Add Your Axes section.
Updated the Obtain Axis Information section.

1756-UM001F-EN-P, May 2005

No changes documented.

1756-UM001E-EN-P, August 2002

Change
Added information about the battery life of the 1756-BA1 battery when you use it in a ControlLogix5563 controller.
Added information about the 1756-BATM ControlLogix battery module.

1756-UM001D-EN-P

Revision not published.

1756-UM001C-EN-P, June 2001

Change
Added the Configure an EtherNet/IP Module section.
Added the Download and Go Online over an EtherNet/IP Network section.
Added the Communicate with 1756 I/O over an EtherNet/IP Network section.
Added the Communicate with 1794 I/O over an EtherNet/IP Network section.
Added the Communicate with Another Controller over an EtherNet/IP Network section.
Added the Communicate with a PanelView Terminal over a EtherNet/IP Network section.
Added the Communicate with an RSView™32 Project over an EtherNet/IP Network section.
Added the Add I/O Modules section.
Added the Create Aliases section.
Added the Schedule the ControlNet Network section.
Added the Communicate with Another Controller over a DH+ Network section.
Added the Route PLC-5 or SLC 500 Messages From a DH+ Network section.
Added the Estimate Execution Time section.
Added the Estimate Memory Use section.
Added the Determine When Data Is Updated section.

1756-UM001B-EN-P, November 2000

Change
Added the Configure a1756-ENET Module section.
Added the Download and Go Online over an Ethernet Network section.
Added the Communicate with 1756 I/O over an Ethernet Network section.
Added the Communicate with Another Controller over an Ethernet Network section.
Added the Communicate with Another Controller over a DH-485 Network section.
Added the Estimate Battery Life section.
Added the Estimate Execution Time (updated numbers) section.

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Notes:

Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support, you can find technical manuals, technical and application notes, sample code and links to software service packs, and a MySupport feature that you can customize to make the best use of these tools. You can also visit our Knowledgebase at http://www.rockwellautomation.com/knowledgebase for FAQs, technical information, support chat and forums, software updates, and to sign up for product notification updates.

For an additional level of technical phone support for installation, configuration, and troubleshooting, we offer TechConnect^{SM} support programs. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/support/.

Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

United States or Canada	1.440.646.3434
Outside United States or Canada	Use the Worldwide Locator at http://www.rockwellautomation.com/support/americas/phone_en.html, or contact your local Rockwell Automation representative.

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